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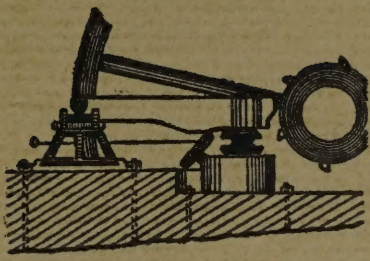

New Jersey Agricultural Society
Trenton, New Jersey
1960

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FORGOTTEN MILLS OF EARLY NEW JERSEY

Oil, Plaster, Bark, Indigo, Fanning, Tilt, Rolling and Slitting Mills, Nail and Screw Making

by

HARRY B. WEISS AND GRACE M. WEISS

1781 – 1940

NEW JERSEY AGRICULTURAL SOCIETY
TRENTON, NEW JERSEY
1960

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PREFACE

This study of the early miscellaneous mills of New Jersey, such as oil, plaster, bark, indigo, fanning, tilt, rolling and slitting mills, is the seventh of the series devoted to rural industries that have passed out of existence and that have been forgotten by most persons. The present monograph also includes an account of early nail and wood-screw manufacturing. In accordance with our previous studies, the early detailed methods of operation have been stressed in order to save them from oblivion and because of their interest in comparison with modern methods.

For courtesies extended during the preparation of this account, we gratefully acknowledge our indebtedness to Mrs. Howard C. Sayre, New Jersey State Department of Conservation and Economic Development, Trenton, N. J.; Col. John Cummings, Curator, Bucks County Historical Society, Doylestown, Pa.; Mr. Douglas H. MacNeil, Chief, Bureau of Social Research, State Department of Institutions and Agencies, Trenton, N. J.; Mr. Howard R. Kemble, Camden County (N. J.) Historical Society, who has been especially helpful; Princeton University Library; Rutgers University Library; and the American Iron and Steel Institute, New York, N. Y. We are also grateful to Mr. Donald Streeter of Iona, N. J., for his notes on the early nail industry, which he permitted us to use.

H. B. W. and G. M. W.

CHAPTER I

Oil Mills

FLAX, FLAXSEED AND CASTOR OIL

It was in the early oil mills of New Jersey that linseed oil was extracted from the seeds of the flax plant. The first settlers needed fiber plants, and after the virgin soil was broken flax was usually the first crop, as it needed a rich soil. Hemp was another fiber plant, and both hemp and flax were planted abundantly in areas around New York City. However, the early settlers were more successful with flax. Although nearly everyone grew flax, the areas devoted to this plant were usually small patches. In 1698 Gabriel Thomas,[1] in describing conditions in West Jersey, mentioned "English Hemp and Flax which prospers there exceedingly." The early colonial governors tried to promote hemp and flax culture, but were not too successful. The Assembly in 1765 offered bounties for all hemp and flax of marketable quality that was produced in the colony. Peter Hasenclever in 1760 was reported to have spent thousands of dollars unsuccessfully in an effort to grow flax near Ringwood. Travelers in 1794 said that there were large fields of flax between Elizabeth and Newark, and by that time it was generally cultivated throughout the State, where it was grown both for fiber and for seed. Part of the seed was crushed in local oil mills, and considerable amounts were exported to Europe.[2] It took an acre of flax to make summer clothing for a family of seven. According to the Federal Census of 1810, 847,469 yards of flaxen goods were made by New Jersey families. This material was valued at $350,823.

Flaxseed was broadcast by hand in early May and by the end of July or the first of August the crop was ready to be harvested. The plants were pulled up by hand and tied into bundles having a diameter of four or five inches. These were laid out to dry for several days so that the seeds would ripen and the stalks would cure. After drying, the sheaves were tied into bundles and hauled to the barn. At a convenient time threshing began. There were different methods. Sometimes the flax heads were beaten over a wagon tongue. Sometimes the dry stalks were drawn through a coarse wooden or iron "ripple comb" to break off the seed bolls. At other times the seed was knocked off on the edge of a wooden plank set at an angle. Then the bolls were pounded with a wooden mallet or run through a clover huller. Some of the seed was saved for planting and the balance was sold to the oil mill. The flax stalks were then spread on short grass to be "retted" or "rotted" to soften the fibers enough for the outer bark to separate. After retting, the stalks were raked and tied in large bundles and stacked in the barn. It was then ready for "braking" (breaking) or separating the fibers. Before "braking" the flax was dried in a rude kiln for 15 or 20 minutes. Swingling was the next step. This consisted of beating out the small pieces of bark and separating the fibers. Then came "hackling" or "hetcheling." In this operation the fibers were drawn through long steel teeth fastened in a board. The dressed fibers were then twisted and tied into "knots" of which a hundred made a bale. The flax was then marketed or used at home for spinning. The pulling and "braking" operations were laborious work.[3]

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[1] Thomas, Gabriel. *An Historical Description of the Province and Country of West-New-Jersey in America.* London, 1698.

[2] Woodward, Carl Raymond. *Agriculture in New Jersey.* New York, 1930.

In 1727, David Donald of Scotland invented a rolling machine for beating and scutching flax, and in 1728 this machine, operated by water power, was successfully used in Fife, Scotland. Similar machines were introduced into Ireland. The flax was drawn inwards between two upper, horizontally fluted rollers and emerged between two lower rollers. The operation was repeated until the woody portion was broken sufficiently.[4]

Flax mills apparently were not numerous, as they are mentioned only occasionally in the early newspapers. In the "Pennsylvania Gazette" of April 5, 1770, there is a notice of a 700-acre plantation in Morris County about twelve miles from Morristown on the premises of which there was "a flax or hemp mill capable of dressing 1200 weight of hemp per day." Schmidt[3] mentions a flax mill at Elizabethtown that offered $15 per ton for rotted or unrotted flax. The Prime Hope Mills of Hunterdon County advertised in the "Princeton Whig" of July 19, 1839 that they would buy dew-rotted flax and pay $17 per long ton delivered, on six months credit. Their flax was to be made into bale rope, cords, etc. At the same time the John W. Snyder mill at Clinton offered $16 to $17 for "well rotted flax in the stem and $5 to $8 in trade for cradled flax, if rotted." In 1831 a firm in Bound Brook advertised for 10 tons of swingled tow at 80 cents per hundred "knots." Olcott and Company, of Lepanto Mills, New Hope, according to their advertisement in the "Princeton Whig" of November 18, 1836, offered cash for flax of good quality delivered at their mill. They had facilities for storing "any quantity."

Howard R. Kemble, of The Camden County Historical Society, has called our attention to a flaxseed mill at Hampton (Hunterdon County) which was operating in 1836 as indicated by the following notice reprinted from the "Flemington Gazette" in the "New Jersey Mirror and Burlington County Advertiser" of December 8, 1836.

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[3] Fletcher, Stevenson Whitcomb. *Pennsylvania Agriculture and Country Life 1640-1840.* Harrisburg, 1950.
Schmidt, Hubert. *Flax Culture in Hunterdon County, New Jersey.* Flemington, 1939.

[4] *A History of Technology,* Vol. III. Oxford, 1957.

> FATAL CASUALTY
>
> We are informed that a young man, son of Wm. Chandler, Esq., was killed on Monday by being caught in the machinery of Kinney's Mill, at Hampton in this county.—He was found lifeless on the floor, with his neck and back dreadfully mangled, and the mill thrown out of gear. He had been attending the mill grinding flax seed, and it is supposed was caught in the trunnel head while stopping to adjust some of the fixtures.

As for flaxseed, Nathaniel Ames in "The Almanack For 1763" (Boston) stated that those who bring flaxseed to market "may depend upon having Silver or Gold therefor of those Gentlemen in Boston who advertise to purchase." Farmers in the Province of Massachusetts were urged to grow flax and sell the seed, as it always sold easily for "ready Money." In the same almanac it is said that the exports of flaxseed from Boston amounted to from 1,000 to 1,200 casks of about seven bushels each, that from New York 8,000 to 9,000 casks were exported annually, and that from Philadelphia from 10,000 to 12,000 casks were exported. These exports were mainly to Ireland. Benjamin Franklin, while testifying before the House of Commons in 1766, said that more than 70,000 bushels of flaxseed were shipped annually to Europe.

Even as early as 1748, Kalm, writing about the commerce of New York, mentioned that in some years as many as ten ships were sent to Ireland with nothing but flaxseed. It was reported that flax in Ireland did not produce good seed but the real reason was that the growers made use of the plant before the seed ripened. The sale price of a bushel of seed in New York at that time was 8 shillings, New York currency.[5]

In "The New-York Gazette or the Weekly Post-Boy" of June 30, 1763, James Parsons, in Queen Street near Peck's Slip, New York, offered for sale "Brass Wire Machines, for cleaning flax Seed in the best Manner for shipping." The sale and purchase of flaxseed was a business that occupied the attention of many persons.

Nicholas Gouveneur advertised in 1771 for sale or rent a large convenient storehouse and stable in New Street, Newark, "proper for the Flaxseed Business, for which it was built."[6] In the "Pennsylvania Gazette" for November 24, 1779, John Reynolds, a Trenton papermaker, advertised for flaxseed, also for any quantity of horse or cow tails suitable for making hair ropes. And in the same year in "The New-Jersey Gazette" of January 20, Jacamiah Smith, of Connecticut Farms, New Jersey, was willing to pay 15 shillings per bushel for good, merchantable flaxseed. In the February 24 issue of the same paper, John Plasket of Trenton and Job Phillips of Hopewell offered two dollars per bushel for flaxseed, until April 1. In the 1780's there were flaxseed "works" in New York City where the seed was stored, cleaned, bought and sold.

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[5] Hedrick, U. P. *A History of Agriculture in the State of New York*. Albany, 1933.
[6] "The New-York Journal, or the General Advertiser." Sept. 19, 1771.

James Richmond, of New Brunswick, who sold plaster of Paris, shingles, dry goods, etc., advertised for flaxseed in 1791.[7] Tench Coxe, writing of domestic manufactures in 1794,[8] mentioned the heavy exports of flaxseed and the manufacture of linseed oil that were increasing. There were exported from the United States from August, 1789 to September 30, 1790, 40,019 casks of flaxseed valued at $236,072. And from October 1, 1790 to September 30, 1791, 58,492 casks of flaxseed were exported.

Flaxseed continued to be in demand. In the "True American" of January 6, 1806, John Heever and Co., of the "Trenton Oil Mill" offered to pay the highest price for seed. During the same year in the same paper for March 17, Wm. Mitchell, of Philadelphia, offered the same inducement. Other Philadelphia firms in 1810 offered to clean and put flaxseed in complete order for export. In 1813 the November 2 issue of the "New-Jersey Journal" carried Martin Switzer's offer to buy flaxseed. He lived in "Elizabeth-Town." In "The Fredonian" of October 10, 1816, B. M'Ginness of New Brunswick advertised for a quantity of flaxseed for which he was willing to pay the highest price in cash. In most cases the advertising referred to was continued for quite a few weeks.

Linseed Oil and Oil Mills

The Greeks and Romans imported their best flax from Egypt and the Greeks cultivated it only for the seeds from which they extracted the oil for cooking purposes. During the Middle Ages flax was cultivated all over Europe. According to Pliny, linseed was used for medicinal purposes and the country people of Italy used it in preparing a certain kind of sweet food used for sacrifices offered to the divinities. In the early part of the fifteenth century, Flemish painters knew that a varnish, having good binding and drying properties, was made when linseed oil was boiled. In parts of Europe during the seventeenth century, linseed oil was boiled with a gum or resin in a glazed, covered pot, then strained through a linen bag pressed between wooden boards or iron plates. Various ingredients such as lampblack were added and the finished product was used for varnishing metals.[9]

In this country linseed oil was used by artists and sold by stores specializing in artists' supplies, by house painters, glaziers, and others. The New York City newspapers during the last half of the eighteenth century frequently carried advertisements offering linseed oil for sale. The interest in linseed oil mills is indicated by the advertisement in

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[7] "The Brunswick Gazette," Oct. 18, 1791.
[8] Coxe, Tench. *A View of the United States of America.* Phila., 1794.
[9] *A History of Technology.* Oxford, 1956.

"The New-York Gazette and the Weekly Mercury" of August 15, 1768 wherein Thomas Shaw and Nathaniel Sedgfield, lately from England, reported that they built paper, grist and oil mills. In the same paper a month and a half later, Dominicus Andler, wheelwright from Germany, advertised that he built all sorts of mills, including oil mills, to work by water, wind or horse power. In Germany he had been employed by princes. As reference he gave the name of John Endrest at the North River. In the March 12, 1770 issue of the same newspaper, "Oil men—Cressy and Drury, Lately from England, in Prince's Street Have to sell, wholesale or retail, genuine Linseed Oil, manufactured in this City, and refined in the best Manner, fit for finest Painting: also inferior Oils, at different Prices, and Cakes, which is excellent feed for Cattle, by the Thousand, Hundred, or single Cake." An oil mill near the "Furnace" on the North River in New York City, with a press house, dwelling house and all the necessary utensils, with a 50-year unexpired lease, was offered by James Barclay, who was leaving for Europe, in "The New-York Gazette and the Weekly Mercury" for July 28, 1783.

"The New-Jersey Gazette" (Burlington) of January 7, 1778, carried the following: "Wanted immediately ten or fifteen gallons of good old linseed oil. Any person having such a quantity for sale, may hear of a purchaser by conveying a line to the printer hereof." From August, 1789 to September 30, 1790, there were exported from the United States, 119 barrels of linseed oil with a value of $1,962, according to Tench Coxe. In 1816 in "The Fredonian" of February 8, Eastburn & Ackerman had just received linseed oil which they offered for sale.

Definite records of New Jersey oil mills are rather scarce, and only scattered references to them remain. At no time were such mills numerically plentiful.

SOME NEW JERSEY OIL MILLS

1732. ...., Amwell, Hunterdon County. Oil mill built about 1732 and operated until near the end of the 18th century. (Larison, C. W. *Ancient Village of Amwell.* Flemington, N. J., 1957.)

1766. **HENRY, GEORGE, AND ISAAC BARNES**, Trenton, made linseed oil and ground paints in a stone paper mill built by Daniel W. Coxe about 1766 on the north bank of the Assanpink Creek where it empties into the Delaware River. (Raum, John O. *History of Trenton,* 1871, p. 235.)

1772. **HIGBE, JOSEPH**, Trenton, Hunterdon County. West New Jersey. Mr. Higbe offered a plantation of 100 acres for sale, about ½ mile from Trenton. There was a stream of water on the premises thought to be sufficient for a paper or oil mill, "neither of which being in the county." ("The Pennsylvania Gazette," Jan. 30.)

1779. **WELL, RICHARD**, Burlington. James Smith offered $3.00 per bushel for clean flaxseed delivered to Well's oil mill. Smith sold linseed oil for burning in lamps or other uses, also flaxseed meal for animals. ("N. J. Gazette," March 31, 1779.)

1780. TAYLOR, MAHLON, in this year offered for sale a tract of land on the South Branch of the Raritan River in Hunterdon County, five miles from Pittstown, 12 miles from the Delaware River, 28 miles from Brunswick Landing and 30 miles from Trenton. There was a stone gristmill on the premises, a sawmill, also an oil mill that had been built during the previous summer. The oil mill was 26 x 30 feet with 16 pestles, and "as many more may be set agoing with a very small expense." ("The New-Jersey Gazette," Feb. 9.)

1789. MACKAY AND DIXEY, Springfield. This firm in "The New-Jersey Journal and Political Intelligencer" of November 25, 1789 stated that their oil mill was complete and they had on hand a supply for buyers or for those who wished to exchange flaxseed for oil. They also offered the highest price for flaxseed and had for sale flaxseed cakes for horses, cows and hogs.

1794. RICHARDS, SAMUEL C., Newark, in a notice in the "Newark Gazette" of November 5, 1794, announced that he was about to establish an oil mill as the country was increasing rapidly and oil was being used by everyone who erected buildings.

1800. KING, JOSEPH, Spring Mills, near Milford, New Jersey. This oil-mill, built by Joseph King, was used until the sixties. Two stones were used in crushing the flaxseed. These operated like gristmill stones. (Scheetz. Proc. Bucks Co. Hist. Soc. IV, 725-729.)

1805. HEEVER, JOHN, & Co., Trenton Oil Mills, Trenton. offered linseed oil for sale at 7s. 9d. per gallon, wholesale and retail. ("True American," Aug. 19.) In the November issues of the newspaper, this firm advertised paints, linseed oil, turpentine, varnish, window glass and putty. The advertising appeared from 1802 to 1807 in Trenton newspapers.

1811. WOOLSEY, JEREMIAH, Trenton, was doing carding, spinning and weaving of wool at his factory in the building known as the "paper mill" or "oil mill." (*Early Woolen Industry of New Jersey.*)

1812. ...., Pittsgrove Township, Salem County. Oil mill established about 1812. Flax was grown abundantly for many years in the vicinity for fibre and oil. (Cushing & Sheppard.)

1813. GIEGER, GEORGE, "Elizabeth-Town." "Flaxseed wanted at the Oil Mill." ("New-Jersey Journal," Oct. 26.)

1816. SHAFER, ABRAM, Stillwater Village, Sussex County, with his two sons, Nathan and Peter, ran a store, gristmill. oil mill, tannery, blacksmith shop and distillery.

1820. PRALL, JOHN, JR., Prallsville, had a notice in "The True American" (Trenton) of February 7, 1820 in which he advertised saw, plaster, and oil mills for rent, in the pleasant village of Prallsville, near Centre Bridge, Amwell, Hunterdon County, along with a dwelling, storehouse. porkhouse, two barns, a smoke house and several truck patches. These properties were still for rent in March, 1821, according to an advertisement in "The True American," signed by Wm. L. Prall, acting as agent for John Prall, Jr.

1823. WADE, OLIVER, Springfield, had an oil mill as well as a tannery, etc. ("N. J. Jour. & Elizabeth-Town Gazette," March 11.)

1826. HALLOCK, JOHN, owned a fourth interest in a 3,000-acre property in Washington Township, Burlington County (an industrial activity that moved in after the close of the Wading River Slitting Mill) which included among other items. a sawmill, gristmill, castor oil press and a linseed oil mill. Hallock's interest was to be sold at a public sale on February 2, 1826, at his dwelling house on the property. ("N. J. Mirror & Burl. Co. Advertiser.")

1837. **Moore, Joseph**, Trenton. Production for one year, 24,000 gallons of linseed oil. Capital $20,000. Moore also operated a gristmill which ground 60,000 bushels of grain yearly. Capital $40,000. In operating his oil mill he used 117 square inches of water under a 3-foot head, and for the gristmill, 150 square inches of water under a 3-foot head. (Joseph C. Potts, "New Jersey Register," 1837.) In 1834 Joseph Moore built the flour mill on the corner of Warren and Factory Streets and the adjoining oil mill on Factory Street. Joseph, Charles and Imiah Moore carried on the oil business until about 1844, when Joseph withdrew. The remaining brothers were still in business around 1870. (Raum, John O. *History of Trenton,* 1871, p. 240.) Moore's mills were located on the race of the Trenton Delaware Falls Company.

1870. ...., Frenchtown. According to Grier Scheetz, the last flaxseed mill to operate in the east was one at Frenchtown which was in business during the early 1870's. (Proc. Bucks Co. Hist. Soc., Vol. IV, 725-729.)

1886. **King. Joseph**, Pittstown. This was another Joseph King who operated an oil mill at Pittstown until his death in 1886. Two stones were used in crushing the flaxseed. These operated like gristmill stones. Around 1900 the site of this mill was used by an apple brandy distiller named John Kraut. (Scheetz, Proc. Bucks Co. Hist. Soc., Vol. IV, 725-729.)

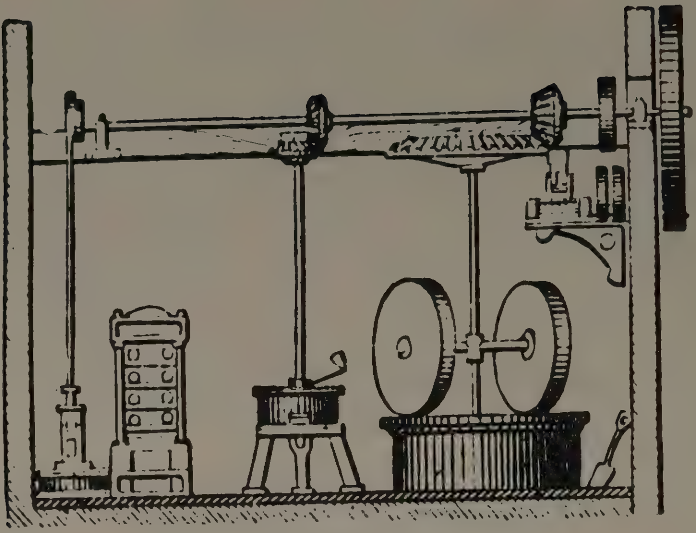
1917. **Pursel, Mrs. Stacy B.**, Spring Mills, near Milford, New Jersey. At a meeting of the Bucks County (Pa.) Historical Society on January 16, 1917, Mrs. Pursel said that she owned the abandoned oil mill at Spring Mills formerly in possession of her grandfather, Joseph King. (See entry under 1800.) This mill was operated as an oil mill until the 1860's. The Joseph King who owned the oil mill at Pittstown (See entry under 1886) was Mrs. Pursel's uncle.

In the "Trenton Federalist" of February 9, 1829, a Pennsylvania oil mill was offered for rent by Elias Ely. It was situated on the "Great Spring commonly called Ingham's Spring," about two miles from New Hope, Pa. It was in good order, had an iron press and there was a good supply of water.

According to the 1810 Federal Census, New Jersey's oil mills and production were distributed as follows. The number of mills in Essex County was omitted.

County	No. Mills	Gallons	Value in dollars
Essex	..	18.800	18,800
Sussex	3	4,500	4,500
Hunterdon	2	5,350	5,350
Salem	1	950	950
Totals	6	29,600	29,600

In the "Votes and Proceedings of the Forty-Fifth General Assembly of the State of New Jersey," Trenton, 1821, a total of 16 oil mills is listed for the state, each one being valued for taxing purposes at $10.00 each. These mills were distributed as follows: Essex County, 2; Burlington County, 3; Hunterdon County, 7; Morris County, 2; and Sussex County, 2. About 10 years later, or around 1830, Gordon locates 22 in Hunterdon County, 6 in Warren County, 2 in Essex,



Mill, heater and press combined.

(From *Knight's American Mechanical Dictionary*. Boston, 1876)

and 1 in Morris, or a total of 31 for the state. In the years 1834 and 1835, oil mills were valued and rated at any sum not exceeding $9.00. The 1840 Federal Census credits the state with 22, distributed on a county basis as follows: Essex, 1; Gloucester, 1; Hunterdon, 9; Mercer, 1; Morris, 4; Somerset, 1; and Warren, 5. Finally we have the 1860 Federal Census figures. At this time the number of oil mills had dwindled to 3. In Kirkbride's Directory for 1850-51, S. Vansyckle of Little York is listed as having an oil mill, also J. & C. Moore of Trenton.

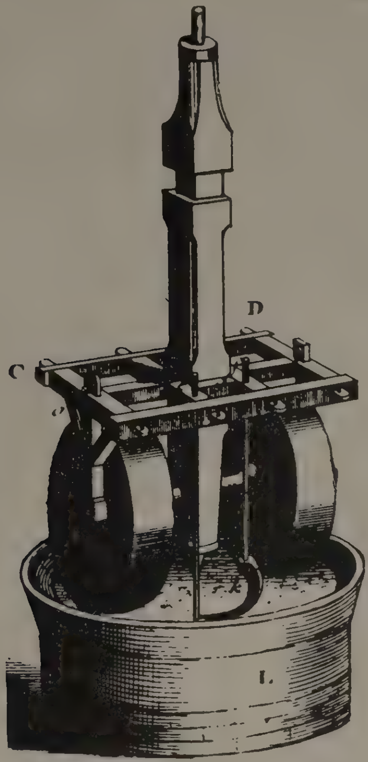
Linseed Oil, 1860

County	No. Mills	Capital Invested (dollars)	Cost Raw Material (dollars)	No. Hands	Annual Labor Cost (dollars)	Annual Cost of Products (dollars)
Hudson	1	100,000	176,900	12	8,400	191,200
Hunterdon	2	3,200	7,600	3	936	10,320
Totals	3	103,200	184,500	15	9,336	201,520

Oil Mill Operation

For the most part, New Jersey's oil mills were small, at first operated by hand, then by horse power and later by water or by wind. The seed was crushed by running it through rollers. Pressing was invented for the purpose of squeezing the juice from fruits and seeds. This was done at first by treading with the feet. The Egyptians (3000 B. C.) in connection with the use of the bag press found that by twisting, it was possible to exert more pressure than by using weight. They filled a cloth with grapes and folded it in a manner so as to engage the two ends on each side in a stick of wood. By turning the two sticks in opposite directions, the contents of the cloth were turned in opposite directions and the pressure was greater than could be gotten by treading. This method was improved upon later. A bag containing the grapes was hung in a frame, and a noose fixed to one of the upright posts replaced one of the sticks. To the other end of the bag was a stick that was twisted by a man.

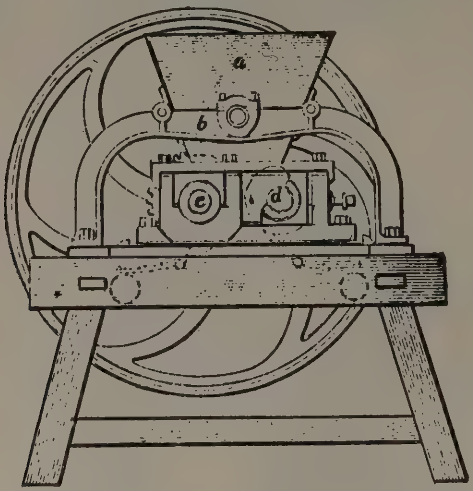
The Aegean people supposedly invented and developed the beam press in which the lever principle was applied. One end of the beam was hinged and the other end was drawn down by a rope and loaded with large stones. In this way pressure was exerted. Such a press was improved. The beam, instead of being drawn down by a rope and drum, was operated by a wooden screw turned by handles. Then later the screw was used as a source of direct pressure. A wedge press was also used in early times. Wedge and screw presses were used mostly for expressing oil from seeds. In constructing a wedge press, a foundation of stones was first made. This contained a depression to hold what was to be pressed. Two strong wooden frames were built over the foundation. Over the material in the depression was placed a plank. On top of the plank were placed, alternately, layers of wedges and planks. The upmost plank was kept in place by the upper



Eighteenth century French mill for crushing various vegetable substances from which oil was later extracted.

(From *Diderot's Encyclopaedia,* 1751-1780) crosspieces of the two frames. The wedges were then pounded in by long-handled hammers in the hands of men standing on each side of the press. In such a way pressure was applied to the material in the depression of the foundation. The expressed juice was conducted to a receiving receptacle by a spout.[10]

Rawson has described a primitive mill as consisting of a single set of stones and one press. The crushing of the flaxseed was done by circular, gristmill-like stones that were attached to a short axle (like cart wheels) and connected to a perpendicular shaft. Two movements resulted. The stones moved on their own axis and on the axis of the shaft. The stones revolved on a stone bed on which the flaxseed was placed and crushing was kept up until the seed became a paste when mixed with hot water. It was then put into a bag and subjected to pressure, by which means the oil was extracted and then put into barrels. Some mills had a capacity of one barrel daily. Another early method was to place the flaxseed on a large stone floor. Around an upright shaft on the floor, two large gristmill-like stones, sometimes ironshod, revolved and turned in a circle. After the seed was crushed, it was shoveled into an iron barrel about six feet long which was turned in a fireplace over a wood fire. Here it remained until it was well cooked. Then the seed was put in strong, smaller iron barrels, each of which had a movable head. Each barrel was put into a large, hollowed-out log with solid ends. Then a press with cogwheels and screw was started and the movable head of each barrel was pushed inward and the oil flowed out into a log trough and then into a re-



Mill for crushing seeds previous to oil extraction. Seeds are fed from hopper *a* by roller *b* and pass between crushing rollers *c* and *d*.

(After *Knight's American Mechanical Dictionary,* Boston, 1876) ceptacle for removing it. After the oil had been expressed the oil meal remaining was ground and used for animal feed. To furnish a quick-drying oil, it was necessary to boil it.[11]

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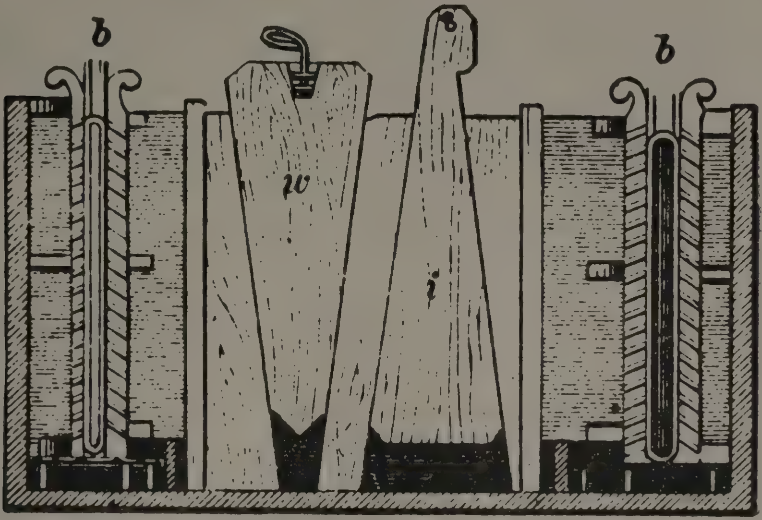
[10] Forbes, R. J. *Studies in Ancient Technology,* Vol. III. Leiden, 1955.

Grier Scheetz, writing about Pennsylvania flaxseed mills, said that the seed was crushed by two millstone-like stones but thicker and the size of a large cartwheel. These were connected by an axle, and also connected to a central upright shaft of wood made to revolve by water power. The seed was crushed by the stone wheels as they traveled around a cast-iron foundation. After crushing, the wet, oily mass was placed in a strong horsehair bag and put into a receptacle with a wedge on each side. "The wedges were drawn by two logs of wood weighing about 600 pounds each, which were lifted by water power to a certain height and dropped upon the edges exerting a pressure of about 6 tons." The oil cake left after the extraction of the oil was ground again and used as cattle feed. The oil expressed by this method was known as cold-drawn linseed oil. This was much clearer than the oil to which heat had been applied. Such was the method in use up to about 1830.[12]



WEDGE PRESS

Hair-bags *b* containing crushed seeds are placed between perforated cheek plates, which allow the expressed oil to escape downward to a cask below. The space between the bags and their enveloping plates is occupied by blocks and wedges. The tightening-wedge *w* is driven by a maul or vertical stamper operated by a wiper wheel and is considered to be tight enough when the stamper makes three bounds from it after a blow. Time being allowed for the oil to exude, the wedges and blocks are loosened by blows upon the inverted wedge *i*.

(From *Knight's American Mechanical Dictionary.* Boston, 1876)

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[11] Rawson, Marion Nicholl. *Little Old Mills.* New York, 1935.
[12] Scheetz, Grier. "Flax Seed Mills." Proc. Bucks Co. Hist. Soc. Vol. IV, 725-729.

Other persons have described the flaxseed as being ground between two millstones as grain was ground. Then it was put in sheet-iron pans and heated over an oven fire. After this it was placed in canvas bags and put under the press. The press had a revolving wooden shaft with arms extending from its side. As the shaft revolved, the arms caught two wooden logs about 12 feet long, and these were lifted up about three feet, when the arm released them and dropped them alternately on the wedges of the press.

At the Museum of the Bucks County Historical Society at Doylestown, Pennsylvania, there is a truncated cone-shaped stone weighing perhaps 600 pounds. The diameter of the large end is 28 inches and the length of the stone is about 30 inches. The opening at the large end, which is about six inches square and six inches deep, continues as a narrow circular opening to the narrow end which has a diameter of 18 inches. This stone is supposed to have been used in a mill for crushing flaxseed, where it was pulled around a circular bed by animal power, either man or beast.

In the "Trenton Federalist" for February 23, 1829, an oil mill was offered for rent on the Great Spring commonly called Ingham's Spring about two miles from New Hope, Pa. It was in good order and had an iron press and an abundant supply of water. Applicants were to apply to Elias Ely of New Hope.

Knight mentions a roller mill for bruising flaxseed before it is ground under edge-stones and before pressing. The seeds are placed in a hopper and fed downward by a small roller within the hopper to crushing rollers geared to rotate in opposite directions. The crushed seeds fall into a box beneath the machine. The rollers are turned by a hand crank.[13]

A wedge press was patented by a man named Perkins on August 30, 1832. This type of press was formerly used mostly in Europe for expressing oil from crushed seeds, such as those of flax, hemp, olive, castor, etc. It was displaced in most cases by the screw press, which in turn was displaced by the hydraulic press. Knight has described the wedge press and its operation. (See explanation under the illustration.)[13] After the first time the bags of flaxseed were subjected to pressure, the oil was known as cold-drawn. It was then of the best quality. The meal was then subjected to the action of stampers and oil of second quality was expressed. The magma was then heated and a body of third quality oil was expressed. Another inferior quality oil was gotten by boiling the ground cake in water. After being expressed three times, the cake was suitable for cattle feed. After the fourth expression, the cake was used as manure.

The only figures that we have seen about the finances of oil mill operation relate to the oil mill of John Schantz, who founded an oil mill in 1814 in the Hosensack Valley, about a mile east of Hosensack, Pennsylvania. In 1843 John Schantz bought 1,148 bushels of flaxseed for an expenditure of $1,732.90. He paid 73 producers prices ranging from $1.40 to $1.69 per bushel. He sold during the year 1,195 bushels of meal for $587.50 and 2,052 quarts of linseed oil for $1,464.66, the average price being 71 cents per quart. As a result his gross profit was only $319.26. In 1849 he had a gross profit of $1,665. In 1851 he lost $500.[14]

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[13] Knight, Edward H. *American Mechanical Dictionary,* Vol. III. Boston, 1876.

Howard R. Kemble has called our attention to the following paragraph that was published in "The New Jersey Mirror and Burlington County Advertiser" (Mount Holly) of March 24, 1836 relative to the supposed superiority of oil of sunflower over linseed oil in preserving wood.

"PAINTING HOUSES

"Spirits of turpentine in paint is injurious. Painters think it causes the paint to dry; but the fact is the oil is decomposed by it, and the preservative effect destroyed. In proof of this it is stated that nothing will remove grease or oil spots quicker than spirits of turpentine. The oil of Sunflower seed is said to be equal, if not superior to that of flaxseed, for preserving wood. This plant should be more cultivated, for the sake of its oil, than it is."

In "The American Geography" by Jedidiah Morse (Elizabethtown, 1789) it is stated that a bushel of sunflower seed yields a gallon of oil, which is as mild as sweet oil and which could be used on salads, as a medicine and in paints, varnishes, etc. It was expressed in Connecticut in a way similar to the expression of linseed oil.

Howard R. Kemble has also turned up for us notes on a curious case of spontaneous combustion connected with flaxseed oil. This took place at Ellicot's Patapsco Mills near Baltimore, Maryland, around January 22, 1820. It was first reported in the "Morning Chronicle" and then picked up by the "Columbian Herald" (Woodbury, N. J.) and printed in the issue of February 3, 1820. Joseph Atkinson wrote to the "Morning Chronicle" as follows:

"At my mills, there was an iron kettle, used for holding ashes, it had remained with ashes in from the 5th mo. to the 9th mo. at which time, flaxseed oil was by accident spilled into the ashes; in about 24 hours the ashes were found to be on fire, and wishing to have it fully ascertained whether it was the oil which occasioned the ashes to take fire, I filled a kettle with cold dry ashes, in which I poured a pint of flaxseed oil, and in 24 hours I examined it and found that as far as the oil had penetrated, the ashes were in a state of combustion, and by applying some shavings and chips of wood, it immediately caused them to blaze." Mr. Atkinson gave publicity to the above because he had a fear that many buildings may have been burned down by fires starting in the same way. In its issue of February 23, 1820 the "Columbian Herald" brought the matter to life again by reprinting from "Poulson's American Daily Advertiser" an account signed by one R. P., who referred to the unsuccessful attempt of one Davyanna to duplicate Mr. Atkinson's experiment in spontaneous combustion and to a successful experiment made at the Mint of the United States. The ashes were chiefly from hickory wood, well sifted, and cold. One pint of linseed oil was poured on the ashes. No change of temperature was observed until about 46 hours later when a flame was emitted which continued for an hour. Even after the flame had ceased, ignition continued for about 18 hours.

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[14] Berky, Andrew S. *An Account of Some Hosensack Valley Mills.* Pennsburg, Pa., 1958.

According to Benjamin H. Shoemaker, 3rd, in 1706 Isaac Shoemaker, son-in-law of Gerhard Hendricks and owner of a mill built by Hendricks on Wingohocking Creek, Germantown, Philadelphia, transferred title to a company composed of six partners, of which he was one. The deed refers to buildings, mill and land "through which the oyl mill race doth run." The company was to get capital to build a mill or mills "for the making of oyl of linseed, rapeseed or such other oyls as they should think most profitable." A deed dated 1707 mentions the reconstructed mill as "one oyl mill and one water corn mill both under the same roof." Among the six partners was Thomas Story, who although chosen Mayor of Philadelphia in 1706, refused to serve and was fined 20 pounds by the Common Council. Isaac Shoemaker's son Benjamin advertised linseed oil by the barrel in his Philadelphia shop and in 1759 he reacquired title to the old oil mill property of his father.[14a] At Ephrata, Pennsylvania, during the early days of the community, linseed oil was used in making printer's ink.

CASTOR OIL

Castor oil was known to the Egyptians and Romans, and the seeds of the castor-oil plant, known as castor beans, have been found in Egyptian tombs. The plant also grows abundantly in India, South America, southern Europe, West Indies, etc. In this country it was cultivated as late as 1914 in certain localities in Kansas, Oklahoma, Illinois and Missouri. Known also as *palma Christi,* the plant was described and named by Linnaeus as *Ricinus communis.* The oval seeds, from ⅓ to ½ inch long, are often attractively variegated.

According to Pliny, in Spain the oil was obtained by boiling the seeds in water and skimming off the oil that came to the surface, a method once practiced in America, and in Egypt the seeds were sprinkled with salt and then subjected to pressure to obtain the oil.[15]

[14a] Shoemaker, Benjamin H., 3rd, "Annals of the Shoemaker Family of Germantown." Germantowne Crier, Vol. 3, No. 2, Sept., 1951, pp. 15-21.

[15] *The Natural History of Pliny,* trans. by Bostock and Riley. London, 1892.

The Agricultural Society of South Carolina in 1785 offered premiums for the largest amounts of castor and other oils produced in the state, and in the late 1700's a Mr. Rudolph of Camden, N. Y., had 50 or 60 acres of castor-oil plants under cultivation which yielded from 100 to 150 gallons of oil to the acre. He expressed a large quantity of cold-drawn oil. A few years later castor oil was made extensively in North Carolina. John G. Gebhard of New York in 1800 received a patent for extracting oil from castor beans, and in 1828 large quantities of the oil were manufactured in Illinois and other parts of the West.[16]

Howard R. Kemble, of The Camden County Historical Society, thought that mention should be made of this activity in New Jersey and the following account of its early manufacture in this state is based upon the notes which he kindly supplied. Leah Blackman in her "History of Little Egg Harbor Township, Burlington County"[17] had the following to say about the castor oil manufactory near Tuckerton, New Jersey.

"In the year 1816, John Halleck [Hallock], a public Friend, came from the State of New York to Tuckerton, where he purchased the Nathan Bartlett farm, and entered into the business of raising castor beans and manufacturing them into castor oil, which at that time brought a remunerative price. Halleck initiated some of the farmers of the place into the mysteries of his occupation. They embarked in the castor bean trade, which to most of them proved to be a profitable business, in one instance laying the foundation for the largest fortune ever made in the place, but through the roguery of this one, Halleck, who had taught him the way to wealth, was made a bankrupt: but this perfidious affair laid the foundation for the castor bean aristocracy of Tuckerton.

"In his old age and the days of his poverty, John Halleck frequently made visits to my father, and I have prepared many a meal's victuals for poor wronged John Halleck, and after he left the house my father would remark that Mr. ...., who had ruined Halleck, ought to keep him a gentleman until the end of his life, but such rascals seldom make restitution."

In the same account it is stated that about 1815 Hallock lived in Egg Harbor and during his residence there he frequently preached in the Friends' church. A further note on Hallock and his financial troubles is supplied by the "New Jersey Mirror & Burlington County Advertiser" (Mt. Holly) in which an assignee's sale of J. Hallock's real estate was scheduled for February 10, 1826 at his dwelling house in Washington Township, Burlington County. Hallock was a one-fourth owner of the 3,000 acres known as the Wading River Slitting

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[16] Bishop, J. Leander. *A History of American Manufactures, 1608 to 1860.* Philadelphia, 1868.

[17] This appeared in the *Proceedings, Constitution, By-Laws, List of Members, &c., of the Surveyors' Association of West Jersey,* etc. Camden, 1880.

Mill establishment, 12 miles from Tuckerton. On the property there were a sawmill, gristmill, "a Castor oil Press, on Hallock's reversing Patent plan," a linseed oil mill, and two of "Earl's Patent Shingle Machines." These were all in complete repair, indicating recent use. There was also a large two-story dwelling house with nine rooms, a barn, other outbuildings and a "number of Tenements for work people." Boat navigation was possible from the property, and sloop navigation within three miles. In the newspaper notice, the premises were advertised as valuable to enterprising capitalists and capable of sustaining cotton and other factories. Attention was also called to the timber and cedar swamp land, within two and a half miles of the previously mentioned sawmill and shingle machines.

On February 11, 1826, a public sale was to be held at the house of Andrew Elberson, innkeeper in Tuckerton, of "one equal undivided moiety of the Plantation on which Nathan Bartlet now resides, in the vicinity of Tuckerton, containing about 270 acres; on which is erected a Dwelling house, two stories high, a large Barn, one Rentable house, and a Castor oil Press, all in good repair." There were also 70 acres of arable land, etc. In addition to the half interest in the property on which Bartlet lived, Hallock also had a half interest in the Woodly Farm within eight miles of Tuckerton, together with complete interest in other properties. All Hallock's holdings were to be indicated on his real estate maps that were to be exhibited on the day of the sale. Timothy Pharo was Hallock's assignee.

Kemble is of the opinion that the advertisement accounts for the industrial activities that moved in after the closing of the Wading River Slitting Mill and that Hallock may have been the resident superintendent for the activities along the Wading River between Harrisville and Martha. There is no doubt about his extensive holdings and his active interest in mills and in the manufacture of castor oil.

Tuckerton and vicinity was not the only place involved in the early production of castor oil. The castor-oil plant was extensively grown at Pedricktown, Salem County, around 1830, and about 1,500 gallons of oil were manufactured yearly.[18] In 1830, Pedricktown contained between 20 and 30 dwellings, a Friends' meeting house, two stores, one tavern and one school, and was in the midst of a farming community.

Another place in which the castor bean was cultivated to a large extent was along the Westecunk Creek which rises in Little Egg Harbor Township and "flows south-east through Stafford Township, Monmouth County, into Little Egg Harbor bay." Previous to about 1830 there was a forge along the stream. Around 1834 there were a saw and grist mill and 15 or 20 dwellings in the vicinity.[18]

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[18] Gordon, Thomas F. *A Gazeteer of the State of New Jersey.* Trenton, 1834.

Henry Charlton Beck, in his "Jersey Genesis the Story of the Mullica River" (1945), in the chapter "Leeds of Leeds," tells of interviewing Mrs. Carrie J. Bowen who said that the two villages, Leeds Point and Smithville, were known together as Leeds until about 1844 and that a castor oil factory "stood directly across the road from the old Leeds house of Jesse Mathis, the one with a foundation made of ballast stones. It was owned and operated by a third Japheth Leeds." Gordon (1834) places Leeds Point in Galloway Township, Gloucester County, 44 miles southeast of Woodbury, and Smithville two miles east of Leeds Point. In 1837 Atlantic County was formed from the townships of Galloway, Hamilton, Weymouth and Egg Harbor in Gloucester County. In any event, another castor-oil factory is accounted for, which operated some years later than the ones previously recorded.

In "The National Gazette and Literary Register" of Philadelphia for February 7, 1825, Samuel C. Bunting, 93 North Second Street, advertised that he had just received three barrels of castor oil "from Jersey" which he offered for sale. And in the "American Sentinel and Mercantile Advertiser," also of Philadelphia, for August 27, 1824, George H. Burgin offered for sale at his drugstore on the southeast corner of Third and Arch streets, "superior first and second quality cold-pressed Castor Oil." He also wanted to buy a quantity of "clean and first quality Palma Christi or Castor Beans."

The castor-oil beans, or seeds, were first bruised between heavy rollers and then pressed in hempen bags in a screw press. The best variety of oil was obtained by pressure in the cold. This was known as cold-drawn castor oil. When the pressed seeds were heated or steamed and pressed again, an oil second in quality was obtained. This oil would solidify or freeze in cold weather. About two gallons of oil were obtained from a bushel of beans. The oil was used largely in the arts, and in medicine as a purgative, and was disagreeable to the smell and taste.

Castor oil is a "fixed oil" or one which is not readily volatile, as distinguished from the volatile or essential oil. The name "fixed oil" is applied to the liquid fats found in the fatty tissue of plants and seeds, and in animals. The essential or volatile oil belongs to the class of odiferous compounds such as ethers, aldehydes, esters, etc., obtained from plants to which they impart odors.

The manufacture of castor oil around 1900 was confined mainly to Jersey City, New Jersey, and St. Louis, Missouri. The Baker Castor Oil Company of Jersey City, with a labor force of around 30 in 1901 and 40 or 45 employees about 1906, pressed much of the imported castor beans, and a St. Louis mill handled mostly the beans of western states. Both firms used hydraulic presses in crushing the seeds at that time and the only further treatment was one that removed foreign matter. The seeds were not decorticated as cotton seeds were in the manufacture of cottonseed oil. In the "New Jersey Industrial Directory for 1958-1959," a Baker Castor Oil Works is listed from Bayonne, New Jersey, as a division of the National Lead Company.

Sometimes the seeds were steamed before being pressed, and although the steaming permitted a more rapid extraction, the oil obtained was inferior for medicinal and other purposes. The castor pomace or residue had value as a fertilizer, but was poisonous to stock. In some areas it was applied as a fertilizer for tobacco and other plants. The oil was used in the dyeing of cotton goods after being converted by means of acids into a sort of soluble oil. In the rural, southern part of the United States around 1910 it was popular as a purgative. In addition, the oil was also used in the manufacture of sticky flypaper and of "glycerine soap."[19] Between the years 1830 and 1850 farmers in Illinois grew castor beans in quantities large enough to support several oil mills. The oil was burned in lamps. Later manufacturing was centered in St. Louis and the oil was used mainly in medicine.[20]

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[19] Bailey, L. H. ed. *Cyclopedia of American Agriculture.* New York, 1909.
[20] "Illinois in 1837," *Niles' Register,* LX, 400, Aug. 21, 1841.

CHAPTER II

Plaster Mills

Although plaster mills were not numerous in New Jersey one hundred and fifty years ago, their output, together with that of mills in neighboring states, was sufficient to supply many New Jersey farmers with "land plaister" or gypsum for a period of 25 years or more, or until its use went out of fashion. Richard Peters, president of the Philadelphia Society for Promoting Agriculture, was the discoverer and principal advocate of the use of land plaster in America. Before the Revolutionary War was fought, he had observed the effect of gypsum on a city lot on the Commons of Philadelphia. Obtaining a bushel, he applied it to red clover and other crops and noted its astonishing results. Around Philadelphia by 1783, the use of plaster on grass and plow land had become a regular practice. Its use spread and some thought it was an easy way to bring back depleted soils. It stimulated the culture of red clover and grass and indirectly the keeping of more livestock and the production of more animal manure. In 1797 Peters published a pamphlet giving the results of his experiments with land plaster. This was entitled "Agricultural Enquiries on Plaister of Paris" and therein it was claimed that plaster was a fertilizer. Peters was a judge of the District Court of Pennsylvania and the owner of Belmont in Fairmount Park, his country home.

Gypsum is hydrous calcium sulphate ($CaSo_4 2H_2O$) and in addition to its use as a dressing for soils it was used for making plaster of Paris. At first it was imported from Europe, then later from Nova Scotia, arriving as ship ballast. In 1816, tons of it came to Philadelphia. Quarries on Cayuga Lake and other deposits in western New York supplied large tonnages. It was not expensive and was usually applied at the rate of two or three bushels to an acre, being broadcast by hand mixed with soil. Applications were made in early spring or late fall. Sometimes it was mixed with small grains before they were planted.[1] Colonel Erkuries Beatty, who farmed just outside of Princeton, New Jersey, and who kept a daily journal of his operations during the years 1797 to 1799, inclusive, recorded the "sowing of Plaister of Paris" each year, during April.[2]

There were many signs by 1810 that gypsum was not a cure-all and also that it was not a fertilizer, but rather a stimulant whose best use was on sandy or gravelly soils. Later, crops on all soils started to decline. Finally Judge Peters accepted the view that gypsum was not what it had seemed to be at first. By 1825 land plaster was generally supplanted by lime and by 1830 liming was a common practice of the better farmers. However, the use of land plaster persisted and in the "Trenton Federalist" of March 23, 1829, we find plaster being recommended on the authority of Mr. Buel, a practical farmer, who said it could be applied to pastures and meadows that were not absolutely wet and that it formed a constituent of many grasses. He also said it was good for corn, potatoes and perhaps peas, beans, etc., that it was not a substitute for manure and that from one to two bushels per acre were sufficient as an annual dressing.

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[1] Fletcher, Stevenson Whitcomb. *Pennsylvania Agriculture and Country Life, 1640-1840.* Harrisburg, 1950.

[2] "Farm Journal of Erkuries Beatty" in library of The New-York Historical Society.

From the "Votes and Proceedings of the Forty-Fifth General Assembly of the State of New Jersey" apparently only twelve plaster mills could be located around 1821 for taxing purposes. Each mill was assessed for $5.00. Two mills were in Somerset County, five in Hunterdon County and five in Sussex County. Gordon[3] for 1830 locates nine mills in all, including four in Middlesex County, three in Burlington, and one each in Morris and Warren counties. Barber and Howe[4] for 1840 mention only two, one in Sussex County and one in Warren County. These somewhat unsatisfactory figures reflect only an approximate situation. Kirkbride in his "Business Directory for 1850-51," mentions three "clover and plaster" mills in Sussex County, those of Thomas P. Hunt, Greenville; James Kyle, Greenville; and Jacob Smith, Flatbrookville. Five are mentioned for Warren County, as follows, being listed as mills, "Plaster, &c.," John Histon, Springtown; J. Fluck, Jacksonburg; William Drake, Marksboro; William Clarke, Hackettstown; and J. R. Butz, Butzville.

According to the Federal Census for 1860 there were twelve plaster mills in New Jersey distributed as shown by the following table.

PLASTER, GROUND, 1860 CENSUS

County	No. Estab.	Capital Invested (dollars)	Cost Raw Materials (dollars)	No. Hands	Annual Cost, Labor (dollars)	Annual Value of Products (dollars)
Hunterdon ...	2	1,500	800	2	480	1,525
Mercer	1	2,000	800	2	720	1,800
Somerset	3	4,500	1,800	3	780	3,185
Sussex	2	3,000	3,720	2	552	4,520
Warren	4	4,300	3,150	4	1,440	5,000
Total	12	15,300	10,270	13	3,972	16,030

It may be noted that these mills were small, each being operated by one man, and that the average investment was only a little over $1,000 per mill. If it appears strange that there were as many as twelve mills in New Jersey by 1860, it should be remembered that although the use of plaster as a soil dressing had been discontinued many years previously, it was still used for making plaster of Paris, in stucco work, by manufacturers of millstones and by builders. For such uses it was sold extensively by lumber firms and others.

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[3] Gordon, Thomas F. *A Gazetteer of the State of New Jersey.* Trenton, 1834.

[4] Barber, John W., and Henry Howe. *Historical Collections of the State of New Jersey.* Newark, 1844.

SOME NEW JERSEY PLASTER MILLS

1797. WADE, JONAS, Connecticut Farms. "Plaister of Paris" was ground "fit for use" and sold by Jonas Wade at his works in Springfield, by the ton or smaller quantities. He also sold liver oil by the barrel. ("The New-Jersey Journal," Oct. 25. Elizabeth.)

1800. TOMMY GITHENS' PLASTER MILL, Haddonfield. One of the mills in the vicinity of Haddonfield was known as the Haddon Mill. This was a one-story frame building situated on the edge of Redman's Woods on the north branch of Newton Creek about one-fourth of a mile from what is now known as Westmont. It was on the plantation formerly owned by John Hinchman and was built before 1800. In later years it was called "Tommy Githens' Plaster Mill," after a veteran blacksmith long and favorably known to the older residents of Haddonfield. (Boyer, Charles S. "Indian Trails and Early Paths," Vol. 2, Part 2, of publication of Camden County Historical Society, 1938.) (See account in text.)

1802. COMBES, N., Lamberton on the Delaware River, near Trenton. Combes sold plaster of the first quality. He had on hand 200 tons, for sale at $14 per ton, and 6,000 bushels "ground to the proper size" for sale at 5 shillings per bushel. Purchasers of five or more tons received an "abatement" of $1.00 per ton. Purchasers of 50 bushels or more paid 3 pence per bushel less. At his mill the grinding was not done by water but by a "dry" screw mill made by W. French of New Jersey. His method of grinding yielded 24 bushels to the ton. In his advertising, Combes stated that Peter Hunt, merchant and plaster seller in Lamberton, advertised his plaster as being the same as that sold by Combes, but Combes wanted it to be understood that Hunt's plaster was ground through a pair of stones in a powerful water mill. ("The True American." March 23, October 4, October 25. 1802.) Combes in "The Federalist & New-Jersey Gazette" (Trenton) for January 20, 1801, offered for sale at a small price, a stone wheel, platform hoop, shaft and other material for grinding plaster of Paris, as they then stood in his yards, as he was preparing a different kind of works for grinding plaster, specifically a "newly invented dry plaster works" invented by William French. About this time he advertised extensively in various Trenton newspapers about his "newly invented dry works."

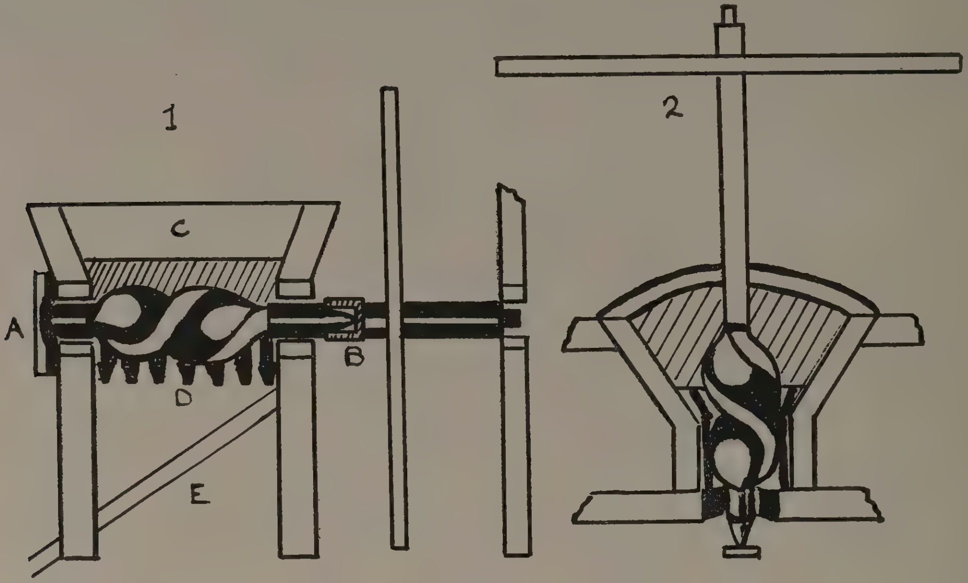
In the "Trenton Federalist" for October 13, 1806, William French advertised that he had obtained a patent right for a screw mill "for mashing plaster of Paris or other hard substances so as to be ground in millstones." His "right" covered New Jersey, New York, Connecticut. Rhode Island, Massachusetts, New Hampshire and Vermont. The machine could be erected in "horizontal, vertical or conical directions with or without grates, with flat square hollowed screw, twisted or straight bars of iron that may be erected so as to discharge the plaster in a hopper or in the eye of the millstone so as to lessen the labor." The screw mill when constructed with a water wheel, with the labor of two men, could manufacture ten tons of plaster daily.

1802. RANDOLPH'S MILLS (formerly Dumont's) on the Raritan River two miles below New Brunswick. This firm manufactured ground "Plaister of Paris" and kept a constant supply at the mills, and also at the store of John Baker, Burnet Street, New Brunswick. ("The Guardian," March 11, 1802.)

1804. **Bolton, Jones & Co.**, Birmingham Works, on Rancocas Creek between Mount Holly and "New-Mills." This firm manufactured plaster. ("The True American." April 9, 1804.)

1807. ...., Swedesboro. A plaster mill was built here about 1807, at the head of a pond on property owned about 1886 by Henry Mitchell. It was one story high. In 1816 machinery was installed to card wool. Later it was enlarged by the addition of a fulling mill. It was bought in 1825 by Charles C. Stratton, who built a gristmill on nearby land. He later became governor of New Jersey from 1845 to 1848. (Camden Daily Courier, Dec. 15, 1880.)

1807. **Coleman, James**, two and one-half miles from Trenton on the main stage road to Princeton. At this location he had erected a mill for manufacturing "Plaister of Paris," where he also kept a supply for sale on reasonable terms. ("The True American," March 14, 1807.) Coleman's place was in Maidenhead Township. He was still advertising in 1809 in the "Trenton Federalist."



THE OLIVER EVANS SCREW MILL, 1795

Figure 1. Section showing the screw in horizontal position. A-B, the screw for breaking plaster at rate of 2 tons per hour. Screw, 12-15 inches long. Plaster put in hopper C and broken by hammer strokes until pieces were small enough to be engaged by the screw. Broken pieces passed through grate D and were guided by spout E to the millstones. Figure 2. Screw set vertically.

(Redrawn from *The Abortion of the Young Steam Engineer's Guide,* by Oliver Evans. 1805)

1815. **Coleman, Sarah, and Nathaniel Coleman** offered a plaster mill for rent, situated within two miles of Trenton. The mill was in good order. ("Trenton Federalist," Oct. 23, 1815.)

1815. **Randolph, John F.**, "Piscatoway." Randolph's mill was at "Piscatoway." He ground "Nova Scotia Plaister." ("The Fredonian," May 25, 1815.)

1817. **Kirkbride, John**, Trenton, one mile from the Delaware Bridge, at the Trenton Ferry. At his mill he had a considerable quantity of ground plaster for sale on moderate terms. ("Trenton Federalist," April 14, 1817.)

1818. Imlay, Richard, on April 13, 1818 was operating the plaster mill formerly occupied by James Coleman, near the two-mile stone on the Princeton Road. He advertised French and Nova Scotia plaster of Paris, ground to suit purchasers. He also had plaster for sale at his home in Trenton. ("Trenton Federalist," April 13, 1818.) On May 25, 1818, the "Trenton Federalist" carried a notice asking for persons to settle their accounts with the estate of James Coleman, deceased. The notice was signed by Nathaniel Coleman, acting attorney for Sarah B. Coleman. In the same paper for January 31, 1820, Sarah B. Coleman advertised the mill for rent.

1828. State Prison. Trenton. That this institution operated a plaster mill is indicated by the report of a legislative investigating committee of 1830 which reported among other things the state of the plaster account as follows.[5]

"Plaister Account

"Amount of inventory, Oct. 1st, 1828		$252.82½
"Amount expended on this account for materials, &c		145.62½
"Making whole amount		398.45
"This am't is to be credited with articles sold	$642.47½	
"Amount of inventory, 1st Oct., 1829	111.32½	753.80
"Making the profit on this account for the year		355.35

Apparently the State Prison ground plaster for sale, among its other activities such as making clothing, furniture, nails, barrels, shoes, and sawing stone.

1830. ...., Bordentown. In the 1830's a plaster works was operated near Horner's Bridge on Black Creek, together with lime kilns. (James D. Magee, "Bordentown, 1682-1932.")

1833. Todd, James W., South Branch. In the "Somerset Messenger" for August 28, 1833, Todd advised the public that he would grind plaster during the first week in September only, at his mills, and would have 500 bushels for sale.

1837. Scudder, Wm. & Henry, Princeton. This firm advertised "a constant supply of Plaster for sale by the bushel" at their mills, at 37½ cents per bushel. ("Princeton Whig," May 5, 1837.)

1844. White, George, Lawrenceville, advertised for sale or rent the mill property known as Schenck's Mills located within one mile of Pennington. There was a gristmill, also plaster and clover mills, apparently on the same property. ("State Gazette," Jan. 17, 1844.)

1846. Browning, Edward, & Brothers, Camden. This firm at the foot of Market Street in Camden, at Hollinshead's Ferry, operated a steam mill and was prepared to supply dealers and farmers with ground plaster for land in any quantity. Their location along the edge of the river, according to their advertisement, would save farmers from Camden and nearby counties the expense and delay of crossing the river. ("The West Jersey Mail," March 4, 1846.) This advertisement that was located by Howard R. Kemble was still running a year later. The Browning family controlled for years the Market Street ferry in Camden. It was established by Abraham Browning, Sr., about 1800. (Charles S. Boyer, "Annals of Camden," No. 3.)

1854. ...., Franklin Township, Warren County. One plaster mill. (Barber & Howe, Hist. Coll. State of N. J., p. 488.)

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[5] Barnes, Harry E. *State of N. J. Rept. Prison Inquiry Commission,* Vol. II. Trenton, 1917.

A single mill might grind grain, flaxseed, mustard seed, plaster, etc. If the grinding could not be done by stones it was done by hand. The rock known as gypsum was broken into small pieces by a sledge hammer. The grinding was done in a crude burr-stone mill that was operated by horse power or by water power. These methods of grinding rock were cumbersome, and as a result Oliver Evans of Philadelphia, early American inventor and engineer, was induced to perfect his steam engine so that its power could be used for operating grinding mills and other purposes. Evans described his work on a small engine for a mill to grind plaster of Paris as follows: "The cylinder [was] six inches in diameter, and the stroke of the piston eighteen inches, believing that, with one thousand dollars I could fully try the experiment. But, before I had done with experiments, I found that I had expended three thousand seven hundred dollars,—all that I could command!" However, he succeeded with his engine and preserved his credit. He could break and grind 300 bushels of plaster of Paris or 12 tons in 24 hours. By the end of 1801 Evans had produced a steam engine that worked.

Evans also invented a simple grinding mill. This consisted of a hopper with a coarse screw that revolved over a grating. By this means the rock was broken up and sifted and readied for final pulverizing. This screw mill was invented by Evans in 1795 in a horizontal form. Later it was manufactured to run vertically for charcoal grinding. After being broken in the screw mill, the plaster was guided by a sloping spout to the millstones where it was ground finer. Evans patented his mill in 1796.[6]

Evans obtained his gypsum from Nova Scotia. Around 1797 from his place of business at 126 South Second Street he issued a leaflet printed in English and German advertising "Plaister of Paris" which he kept for sale at the "Old Windmill." In this leaflet he stressed calcined plaster of Paris for stucco work. When ground to a fine powder the plaster was ready to be used by farmers as a "fertilizer."

"Plaister of Paris" was widely advertised by retailers in the early newspapers of New Jersey. The following list is a condensed selection of a few of such advertisers.

1789. CONSTABLE, WILLIAM, & Co., of New York advertised plaster of Paris imported from France and manufactured in Pennsylvania for sowing on grass ground or for manuring Indian corn. It was for sale in New York and at the Delaware works of the firm. ("The New Brunswick Gazette," June 2.)

1791. RICHMOND, JAMES, New Brunswick, advertised plaster of Paris and mentioned its value as manure. ("The New Brunswick Gazette," March 29.)

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[6] Bathe, Greville, and Dorothy Bathe. *Oliver Evans A Chronicle of Early American Engineering.* Philadelphia, 1935.

1795. A quantity of French plaster of Paris, ready ground, was for sale at Morrisville in Bucks County, Pa., opposite Trenton. ("New-Jersey State Gazette," Sept. 8.)

1802. Kinsey, John, & Co., of Morrisville, Pa., had plaster ground to different degrees of fineness. This was for sale at their works or at Peter Hunt's in Lamberton, N. J. ("True American," May 25.)

1802. Hillyer, William, New Brunswick, sold groceries and had 90 tons of Nova Scotia plaster for sale. ("Guardian," April 1.)

1804. Brush, Timothy, New Brunswick, sold plaster of Paris, ground and in the stone. ("Guardian," June 14.)

1805. Trenton Mills, Trenton, offered plaster at 4 shillings, 3 pence per bushel. ("True American," Feb. 4.)

1807. Bunting, Samuel L., Crosswicks, offered for sale first quality plaster of Paris. He was willing to take grain of every description in payment. ("True American," Mar. 2.)

1807. Beach and Vanderpool, Broad and Orange Streets, Newark, advertised plaster along with oil, paints, window glass, teas, sugar, liquors, dried cod fish, dye woods, etc. Their plaster came from Nova Scotia. ("Centinel of Freedom," Newark, Jan. 20.)

1809. Wilson and Johnson, "Elizabeth Town," sold plaster at the store of James Wilson. ("New-Jersey Journal," July 24.)

1811. Smith & Nevius, New Brunswick, had on hand "50 tons Plaister Paris," also salt and assorted groceries. ("The Fredonian," July 10.)

1814. Linn & Hardenberg, New Brunswick, advertised "Nova Scotia Plaister," tar, coarse and fine salt, groceries, flour, powder, butter and whiskey. ("The Fredonian," June 30.)

1815. Williamson, W. D., of "Elizabeth-Town," sold dry goods and groceries and stated that he had opened a "Plaister Yard" and had 100 tons on hand of a superior quality.

1816. Hollinshead, Chas. E., New Brunswick, advertised dry goods, groceries. salt and 30 tons of plaster of Paris from Nova Scotia, and 20 tons of French plaster. ("The Fredonian," Sept. 12.)

1818. Stout, Jacob, in the "Centinel of Freedom" for Dec. 29 advised the farmers of Sussex that he would pay cash for first quality wheat delivered to his mill in Belleville and for those who brought wheat to his mill he had on hand plaster of Paris at a reduced price.

1818. Cory, Jonathan, Newark, had for sale, salt, fish, etc., and also "350 Tons, French and Novasootia Plaister." ("Centinel of Freedom." Sept. 15.) In the same newspaper for Sept. 18, 1821, he stated that "Plaister" had arrived on the schooner Carolina and Nancy N. Foster, 12 days from St. Andrews. The cargo was being discharged and was offered for sale cheap.

1836. Atkinson & Cuthbert, South Ferry, Philadelphia, advertised groceries and "170 Bushels of Ground Plaister for land." ("The West Jersey Observer," April 16.)

1836. Cruser, C. C., Scudders Mills, sold plaster. ("The Princeton Whig," June 17.)

1836. Jesse Coxe's Store, Burlington. Ground plaster for sale. ("The Burlington Gazette," April 30.)

1836. Jones & Dutton, Burlington, had a few casks of ground plaster for sale. ("The Burlington Gazette," April 30.)

Apparently some farmers were still using plaster for their land as late as 1836, instead of lime. Of the four 1836 notices of plaster for sale, that of Atkinson & Cuthbert specifically mentions plaster for land.

In Talbott and Blood's "New Jersey State Business Directory for 1866," twenty-six New Jersey plaster mills are listed, nearly all in the northern half of the state. It is supposed that most of them supplied plaster that was used by builders and masons, although some farmers may have continued its use as a land dressing.

Much gypsum during the early days came from quarries along the eastern Canadian coast. Americans gathered it up with no difficulty and without paying for it, and many vessels were employed in transporting it along the coast as far south as Savannah, Georgia.[7] At present in the United States gypsum is found in various areas in New York, Kentucky, Ohio, Michigan, California and Utah.

It is customary now and then to run across nostalgic accounts of early gristmills, but it is unexpected to find a plaster mill written about in the same vein, as Howard R. Kemble did in the library of the Historical Society of Pennsylvania. An unknown author wrote for "The West Jersey Press" (Camden, N. J.) of June 20, 1888, an article entitled "The Old Plaster Mill," in which he waxed eloquently about Tommy Githens' plaster mill on the north branch of Newton Creek, a short distance from Haddonfield. The plaster ground at this mill came to Philadelphia from France as ship ballast in the shape of gypsum, and from Philadelphia it was transported in boats to the head of navigation on Newton and Cooper's creeks and thence by wagons to the mill. The mill had a crusher, one run of stones, screen and other appliances which required but little power. It was probably built by Joseph Hinchman, the owner of a large estate. A woodcut of this mill appears in the April, 1830 issue of "The Casket," where it is entitled "Haddon Mill," probably from John Haddon, one of the early settlers. The historical sketch of the mill is accompanied by verses apparently written by someone very familiar with the rural setting of the mill and many incidents connected with it. As a youth the author had enjoyed the beauty of the spot, the mill dam, the revolving wheel, all of which including the mill itself were in ruins when he wrote the verses.

The mill was operated for many years by Thomas Githens, a blacksmith who had his home and smithy in the heart of Haddonfield village. As the mill was the only place where farmers of the area could buy plaster, it soon became a neighborhood meeting place where all the gossip of the surrounding country was discussed along with religion, politics and crops. Known as Tommy Githens' Plaster Mill, candidates for office, fishermen, even a few Indians and others made a point of stopping there to hear the news at a time when newspapers were almost unknown.

Inside the mill there was a chimney with a wide, open fireplace. For seats a few baskets and empty nail kegs were sufficient. Festoons of cobwebs covered with dust hung from the overhead, rough-hewn beams, and through two windows dimmed with dust the daylight struggled.

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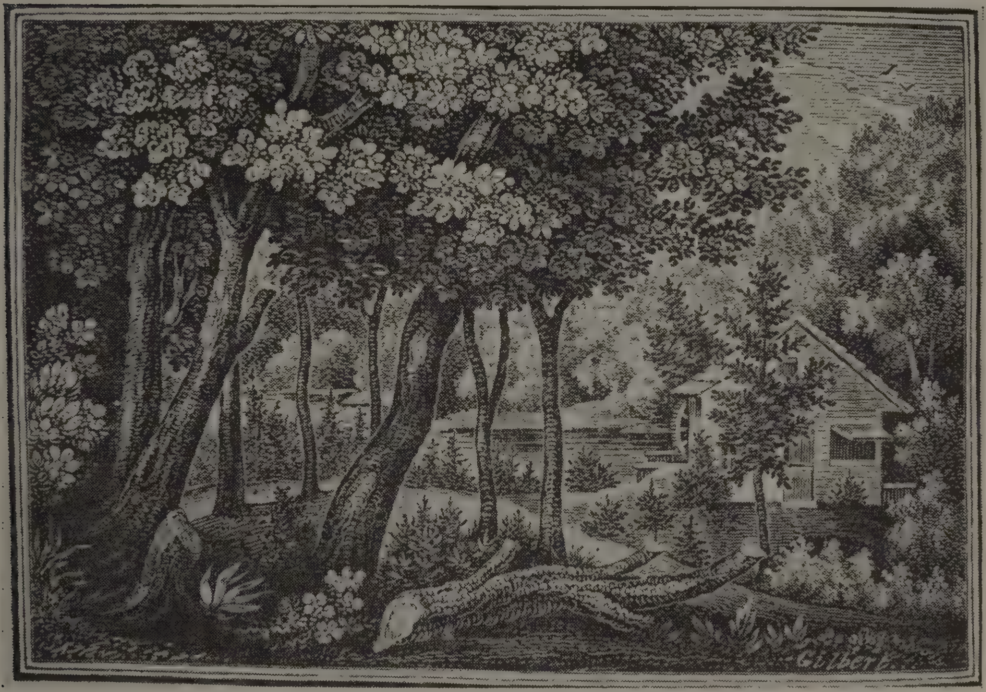
[7] Janson, Charles W. *The Stranger in America.* London, 1807. (New York, 1935)

From the village a crooked road through the woods led to the mill, and for the young people of the neighborhood it was a favorite walk to the grassy, shaded bank of the pond where picnics and social gatherings took place. To the music of a violin the boys and girls sometimes passed a pleasant summer afternoon, and many a Quaker maiden, forgetful ot her parents' admonitions, was tempted to enjoy the Virginia reel or "contra" dance. Tommy Githens never witnessed such breaches of discipline, and although a member of the Meeting he was in sympathy with young folks. From the noise of the mill and the dust of the plaster he was deaf and blind to outside happenings and his memory was conveniently short. When the luncheon cloth was laid on the grass and when the feast was spread, Tommy was always a welcome guest.

"A meek looking man to the mill-work attended,
"His hair wore the silvery aspect of age;
"In his countenance. peace and contentment were blended,
"And much his appearance resembled the sage,"



(The Tommy Githens Plaster Mill)

From "The Casket," April, 1830, where it is labeled "Haddon Mill."
(Courtesy of the Free Library of Philadelphia)

As age made its inroads upon Tommy Githens he was found less frequently at the mill. Neglect made its appearance. Needed repairs were not made. Improvements in machinery lured his customers away. The mill fell into decay and ruin. In his eightieth year, long after his interest in the mill had declined, Tommy Githens died, in 1826.[8]

Thus it is seen that even a dusty, prosaic plaster mill in picturesque surroundings had its place in promoting community welfare, pleasure, romance and probably happy marriages, and in addition happy childhood memories for those fortunate enough to grow up in such delightful places.

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[8] "New Jersey Newspaper Cuttings" scrapbook, Vol. I, UN 494. Historical Society of Pennsylvania.

CHAPTER III

Bark, Indigo, and Fanning Mills

BARK MILLS

During early times the bark of oak, alder, beech, hemlock, larch, poplar, willow and other trees, that was used in tanning was probably pounded with heavy mallets in order to crush it. Later this method was displaced by a bark mill operated by a horse sweep. As the bark was easier to loosen from about the end of April to the end of June, peeling took place at such times. First a few small trees were cut down. Then on the larger trees a cylinder of bark four feet long was removed where "the frontward notch of the axe and the cut of the saw from the rear were to be made." After the tree was felled it was laid on the small trees. The branches were removed and the bark was ringed through to the wood in cylinders four feet long. Each cylinder was opened at the top and removed with a two-inch-wide, narrow spud, or peeling iron, with a thirty-inch-long wooden handle. Free from the tree the bark was leaned against the peeled trunks with the smooth side out so that the wet cambium would be dried by the sun. It was then corded and sold to the tannery. The cylinders were split into longitudinal pieces and dried slowly in sheds.[1]

References to tanbark mills have been found as early as the years 1154, 1217, 1231 and 1279, but these may have been crushing or stamping devices. In grinding the bark, its constituents were made more readily soluble in water. It was not powdered because in that state it would form a compact wet mass which would retard the infiltration of the water. At various periods the bark mills were operated by horse, water, and steam power. In 1676 a Newark, New Jersey, tannery had on its oak floor a large wheel with wooden cogs. This revolved slowly by animal power and crushed the bark. Some bark mills had two wheels, one of wood and one of stone which alternated in crushing the bark by their travels in a fifteen-foot circular trough. There were also stones that operated horizontally like the stones of a gristmill in order to crush or shred the bark into smaller pieces.

An old tanbark mill of the middle eighteenth century, found near East Guilford, Connecticut, consists of a runner stone about five feet in diameter and seven inches thick. It ran on its edge in a circular trough, cut from rock, that was about fourteen inches wide and five inches deep. The outer rim of the trough was about nine inches wide and the inner rim about a foot in width. The outside diameter of the trough was about sixteen feet. The face, or cutting edge of the sandstone runner, was corrugated. This type of mill, known centuries ago, was called an edge-runner. In the center of the mill was a large center stone with a square hole in which a post was set. This post was attached to the shaft on which the runner stone operated. Horse or ox power was used to operate the mill.[2] Bishop, describing tanneries before 1800, mentions a circular trough sixteen feet in diameter in which bark was crushed by alternate stone and wooden wheels turned by horse power. Sometimes bark was ground by water power near the source of supply. At first millstones were used and later iron mills. The coffee-mill type of grinder replaced the edge runners toward the close of the eighteenth century.[3]

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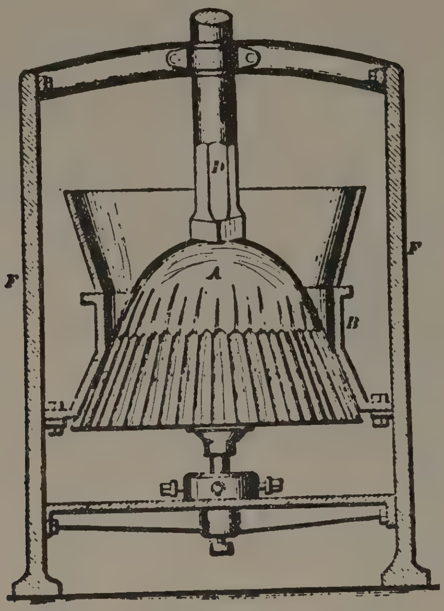
[1] Hedrick, Ulysses P. *A History of Agriculture in the State of New York.* Albany, 1933.



Weldon's Bark-Mill, 1797. *A*. Conical, iron drum provided with teeth rotating in casing. *B*. Upper part of casing forms a flaring hopper. Casing and grinder are supported by framing, *F*. Face of casing is also toothed. Bark is rasped as it passes between the cone and the casing.

(From *Knight's American Mechanical Dictionary*. Boston, 1876)

Morfit described in detail some of the bark mills in use in different countries up to about 1852. He stated that in England the bark was crushed between two millstones. In France, at the time of his writing, a mill in use consisted of two vertical millstones about seven feet in diameter and eighteen inches thick. The axle of the stones was fixed in a frame which enclosed an upright shaft turning upon a pivot, and fixed in the middle of a heavy stone bed. Rotary motion imparted a double movement to each stone, "that upon the other, and that which it underwent in describing a circle upon the stone bed upon which it rolled."[4]

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[2] Warner, Martha E. "The Old Tanbark Mill." Chron. Early Amer. Ind. Assoc., Vol. I, p. 186. 1936.

[3] Bishop, J. Leander. *A History of American Manufactures from 1608 to 1860*. Phila., 1861.

A bark-grinding mill known as Weldon's was in use around 1800. This had a conical iron drum, with teeth that rotated in a toothed, iron casing, both being supported by an iron frame. As the bark passed between the toothed drum and the toothed casing it was rasped.[5]

Around 1811 a patent was granted to Cornelius Tobey for a new, improved bark mill. W. and J. Old had bought the patent rights for eleven eastern and southern states including New Jersey. The grinding part of the mill was of cast iron and it was said that a small boy with a horse could grind three times the quantity that could be ground with a stone. Robert Goodwin, of Trenton, had the right to sell and erect the mill in New Jersey. Three were in operation in Trenton, and one belonging to Thomas Hill in New Brunswick.

According to the Federal Census for 1860, there were five establishments in New Jersey producing tanbark. The capital invested was $9,500; the cost of raw materials, $5,970; the number of hands employed, 6; the annual cost of labor, $1,560, and the annual value of the products, $13,888. From these figures it would appear that by 1860 individual tanners were no longer grinding their own bark.

During very early colonial times a bark mill was owned in common by several tanners. A tanner of Northampton, Massachusetts, in 1794 had a circular trough fifteen feet in diameter in which bark was crushed by alternate wooden and stone wheels, operated by two blind horses, at the rate of one-half cord per day. He also built a bark mill on a stream five miles from his tannery where bark was ground by water power, first between millstones and later in iron mills.

In New Jersey not all tanners mentioned having a bark mill in their newspaper advertising. It is believed that the earliest tanners all had to have their own facilities for grinding bark, or at least own a mill in connection with other tanners. And in view of the mention of a mill house in many notices advertising tanneries for sale, it is apparent that many if not all had bark mills of one type or another. Benjamin Biles of Trenton had a bark mill in 1750; also John Shippey of Raritan Landing, near New Brunswick, in 1793; and Hardenberg and Dunham, New Brunswick, in 1800. In 1806 Joshua Barker, Upper Freehold Township, had a mill house. According to "The Centinel of Freedom" for April 26, 1808, Peter D. Jacobus wanted to sell one-fourth of an interest in an excellent bark mill on the Peckerman River in Caldwell Township about ten miles from Newark and on the turnpike from "Crane-town" to Caldwell. The mill could grind ten tons weekly. In 1821 James Robson of Moorestown had two mills in his tannery; Oliver Wade in 1823 had a bark mill in his tannery at

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[4] Morfit, Campbell. *The Arts of Tanning, Currying and Leather Dressing.* Phila., 1852.
[5] *Knight's American Mechanical Dictionary.* New York, 1877.

Springfield and a water-powered bark mill at Pompton. In 1850 Wm. R. Allen of Burlington introduced the first steam engine into the City of Burlington to supply power for grinding bark at his tannery. This was a traction locomotive formerly used in hauling freight over the turnpike from Philadelphia to Pittsburgh. An unnamed tannery at Whitehouse had in 1827 a bark mill and a stone wheel, and about the same time Job Smith of Mount Holly had an iron bark mill in his tannery. In 1845 Charles Thompson of Mendham bought a bark mill from Daniel Bosworth of Newark for $65.00. He paid $50.00 down during his trial of the mill, and if it worked satisfactorily he was to pay the balance of $15.00. If it was unsatisfactory Daniel Bosworth was to take back the mill and refund $50.00.

In addition to oak bark, sumac was used in tanning, the powdered leaves and young branches being utilized not only in tanning but also in dyeing orange, yellow and black. "The Palladium of Liberty" for August 23, 1821 carried the notice that John Thompson at his mill ("Late Doty's near Basking Ridge") would pay on delivery six shillings in cash for "dry, bright Sumac." Previously in the same year Samuel Doughty had advertised for fifty tons of sumac for his "Morocco Manufactory" in New York. About 1850 there were two sumac mills at Mays Landing, one belonging to Elisha E. Hudson and another to Abraham L. Izzard. Barber and Howe, in their "Historical Collections of New Jersey" (1868), wrote that large quantities of sumac leaves were gathered each year in Pittsgrove Township, Salem County, and dried, pulverized and sent to market. The 1860 Federal Census lists two sumac mills in New Jersey, both in Cumberland County. The capital invested was $2,500; the cost of raw material was $1,700; the number of hands employed was 4; the annual cost of labor was $600, and the annual value of the product was $2,850.

Henry R. Procter described a mill for grinding sumac leaves. It consisted of a solid, circular, wooden bed fifteen feet in diameter, with a one-foot-wide depression a few inches deep around the edge, to receive the ground sumac from the bed. Two edge rollers each five to six feet in diameter, each weighing about 2,500 pounds, and each thickly studded with numerous iron or wooden teeth, revolved around the circular bed and crushed the leaves, which after screening were packed in bags, fifteen to the ton. They were sold by weight.[6]

INDIGO MILLS

Once in a while one comes across early references to indigo mills. For example, after the Good Intent Woolen Mill of Blackwood, N. J., had been destroyed by fire on January 27, 1837, the estimated loss of $19,565 on gearing and machinery included one indigo mill valued at

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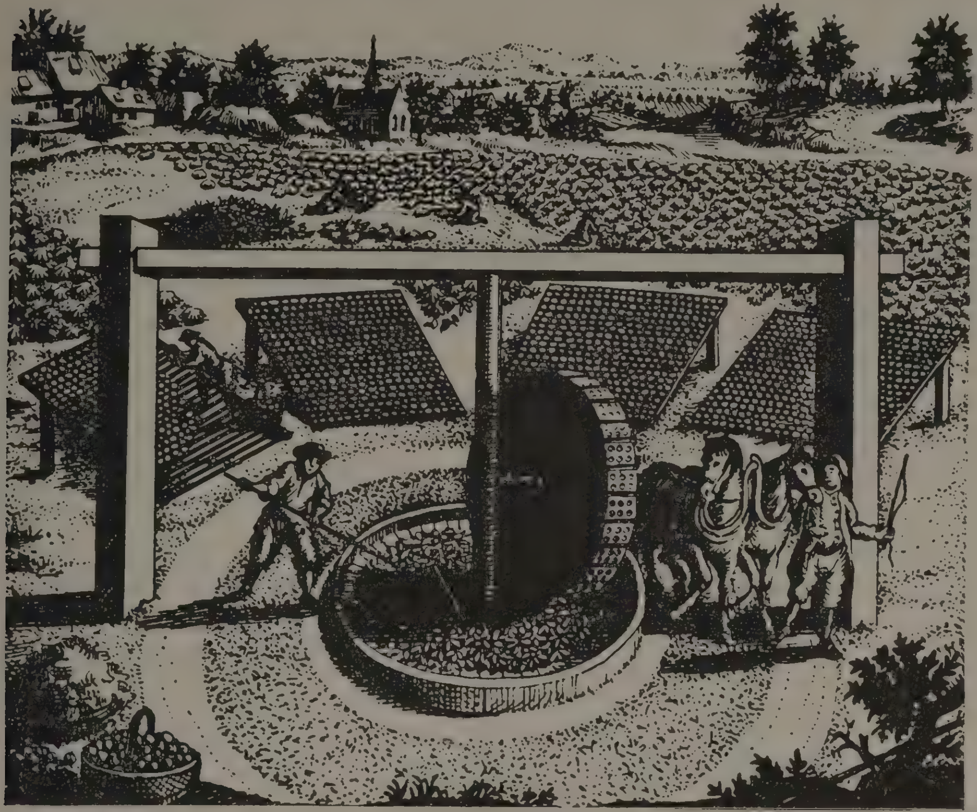
[6] Procter, Henry R. *Text Book of Tanning.* London, New York, 1885.

$50.[7] References to indigo for sale are more frequent in the advertising found in early newspapers, for example, "Excellent indigo to be sold. Enquire of the Printer hereof" which appeared in the "New Jersey Gazette" of February 23, 1780.

Blue as a dyestuff was obtained from the indigo plant, *Indigofera tinctoria* L., or from woad, a biennial, *Isatis tinctoria*. A mill for grinding indigo was figured by Gregory in 1821.[8] This consisted of a hard stone or marble mortar, a pear-shaped, grooved muller (pestle) with an iron axis in the upper part. The axis of the muller turned in slits in two pieces of wood that extended horizontally from a wall. A handle formed part of the axis. The mill was really a mortar and pestle with the mortar on a table and the pestle confined to slits in wooden arms so that it could be rotated in a fixed position in the mortar. The in-



PREPARATION OF WOAD, 1752

Plantation of woad plants in background. Leaves were stripped and shoveled into mill in foreground where they were raked over and ground. The ground leaves were put in heaps to dry and then rolled into balls which were placed on sloping racks for further drying.

(From *A History of Technology*. Oxford, 1956) digo to be ground was thrown into the mortar above the pestle. When the handle of the pestle was turned the lumps of indigo fell into the grooves of the pestle and were driven to the outer edge within the mortar, the coarser particles again falling into the grooves of the pestle and being ground under it.

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[7] Weiss, Harry B. and Grace M. Ziegler. *The Early Woolen Industry of New Jersey*. Trenton, 1958.

[8] Gregory, G. *Dictionary of Arts and Sciences*, Vol. 2. New York, 1821.

In "Knight's American Mechanical Dictionary" (Boston, 1872), an indigo mill is described as "a four sided iron cistern, cylindrical or rounded at bottom, resting upon gudgeons in a wooden frame. It has an iron lid with two leaves, between which works a rock-shaft receiving a vibratory motion from a crank, and imparting a swinging motion to a frame carrying six rollers, three on each side, which triturate the indigo to a fine paste; when sufficiently ground, the paste is drawn off by a stop-cock."

Dyeing dates back to Graeco-Roman times, the most important of blue dyestuffs being indigotin which was derived either from the indigo plant (*Indigofera tinctoria* L.) or from the biennial woad (*Isatis tinctoria* L.). Indigotin was obtained by natural fermentation or bacterial reduction to a colorless and soluble compound known as indoxyl, which upon exposure to air is oxidized to indigotin. The fabric was steeped in the fermenting liquid and after being hung in the air, the deep blue appeared. *Indigofera* is a tropical genus. The Romans used it as a pigment apparently not knowing how to bring indigo into solution. At one time woad was cultivated intensively throughout Europe, especially during the Middle Ages in England. By the twelfth century it was being imported from other parts of western Europe, and was the only blue dye that was used. Except for indigo, the dyes used by colonial women in New Jersey came frequently from nearby fields in the shape of flower petals, berries, bark, etc. Wild indigo supplied blue. As the amount of indigotin in woad was small, from the sixteenth century onward it was replaced by indigo.[9]

After being gathered the indigo leaves were put into a tub of water called the steeping vat. Here they underwent fermentation which after twenty-four hours was completed. The water was then drawn off through a cock into a second tub called the mortar or pounding tub. The steeping vat was then cleaned out and fresh water and leaves were put in. The water in the pounding tub was forcibly agitated with perforated wooden buckets attached to a long handle. The agitation required discrimination on the part of the operator. If discontinued too soon, the part of the material used in dyeing would not separate adequately. If agitated too long, a new combination would result and a second fermentation would occur that would change the dye and spoil its color, resulting in what was called burnt indigo. When the operator noticed that the colored particles were collecting and separating from the balance of the liquor, the buckets were no longer shaken and the blue dregs were allowed to settle to the bottom of the tub. Holes that had been made in the tub at different levels were then opened and the useless water was allowed to run out. The blue dregs remaining as a thick muddy liquid was drawn off and allowed to settle in a third tub, and after settling it was drained into sacks, and after no more water drained off the sacks were put into chests where drying was completed. After three months the indigo was salable. When woad was used, the young leaves were picked, washed and dried hastily in the sun, ground in a mill, placed in heaps and allowed to ferment for two weeks, and then mixed well and formed into balls which were piled upon each other and exposed to sun and wind. In this condition they started to ferment. In order to hasten fermentation the balls were sprinkled with water. After a sufficient time the woad was reduced to a coarse powder which was sold as a dyestuff.[10]

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[9] *A History of Tecnology,* Vol. II. Oxford, 1956.

According to another account (1752), the young woad leaves after being picked were heaped and shoveled into a mill, operated by horse power, where they were raked and ground into a pulp. This pulp was formed into balls which, after drying for a few weeks, were powdered and allowed to ferment with water until converted into a dark mass that was rammed into air-tight barrels and sold. When ready to be used the woad was fermented again in a heated wood vat and the cloth to be dyed was steeped in the fermenting solution and then hung in the air.[3]

England's last woad crop is supposed to have been grown by Mr. Thomas Booth at Kingsway, near Boston, Lincolnshire, in 1936. That area was a traditional woad center until the business disappeared due to the manufacture of synthetic indigo. The woad was harvested by hand, crushed in mills by horse-operated rollers, then molded by hand into round balls about the size of Dutch cheeses. After drying, these balls shrank to the size of balls used in cricket, and they had to be crushed, mixed with water and fermented for some weeks before the dye was ready to be placed in casks and sold to cloth mills.[11]

The indigo plant was cultivated early in the southern colonies, and as early as 1650 Gulian Van Rensselaer experimented with indigo seed near Albany, N. Y., as did also Augustus Heerman, near New York City. Successful cultivation was in effect in the West Indies. Around 1740 the mother of General Charles C. Pinckney was successful in growing the plant in South Carolina from seed obtained in the West Indies. A grower from Montserrat, France, was brought over to instruct workers how to manufacture the dye. After vats were built and an amount of dye had been made, the Frenchman tried to make the process seem mysterious and he became concerned lest he should ruin the industry in his native country. However, he did not succeed in concealing knowledge of its manufacture. In several years indigo began to be exported. During 1741 about 100,000 pounds of indigo were exported from Charleston to England. In 1748 a bounty of six pence was offered on all indigo raised in British North American colonies and imported directly into England. In 1753 Charleston exported 216,924 pounds, and the two Carolinas in 1756 produced 500,000 pounds. In 1754 indigo exported from Georgia amounted to 4,508 pounds; in 1756, 18,150 pounds, and in 1772, 55,380 pounds. A plantation of 50 acres needed the labor of 50 Negroes, and the average yield per acre was 50 pounds. The apparatus needed for the manufacture of indigo was not extensive and consisted chiefly of vats and tubs made from cypress wood. After the Revolution the cultivation of cotton and the manufacture of indigo in British India caused a rapid decline in indigo production in the South.[3] From October 1, 1790 to September 30, 1791, 497,720 pounds of indigo were exported from the United States. From October 1, 1791 to September 30, 1792, a total of 858,996 pounds were exported from the United States. Of this amount 950 pounds came from Massachusetts, 840 from Rhode Island, 1,000 pounds from New York, 2,658 from Pennsylvania, 4,332 from Maryland, 6,250 from North Carolina, 839,666 from South Carolina and 3,300 pounds from Georgia.[12] In "The Diary; or Evening Register" of August 30, 1794, a trunk, brush and Windsor chair manufacturer of 271 Pearl Street, New York City, advertised also that he sold "Carolina Indigo" by the cask or in smaller quantities. Jesse Baldwin, of Newark, New Jersey, according to "The New-Jersey Journal and Political Intelligencer" of February 28, 1786, sold "Carolina Indigo" wholesale and retail, along with rice, bar iron, nails and nail rods. And John H. Stephens in "The Centinel of Freedom" (Newark) of August 15, 1815, advertised for sale one cask of Carolina indigo at a reduced price.

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[10] Nicholson, William. *The British Encyclopedia or Dictionary of Arts and Sciences.* 6 vols. London, 1809.

[3] *Loc. cit.*

[11] Ward, J. D. U. "The Growers of Woad." Manchester Guardian Weekly, June 19, 1958.

Fanning Mills

In China around 40 B. C. a rotary winnowing machine with a crank handle was the subject of experimentation. Similar experimentation took place in Europe around 850. However, it was not introduced into the western world until the 16th to 17th century.[9] The early winnowing "fan," so called, was usually a basket that was agitated in a draught which removed the chaff. Among peasant villages, winnowing probably took place upon a windy hillside. Representations of winnowing have been found in Egyptian tombs. Men with scoops are shown throwing the grain up into the air and a passing wind is blowing the chaff away. When the late Rudolf P. Hommel visited China from 1921 to 1926 to study the primitive industries, he found winnowing shovels, scoops and riddles in use by poor farmers and winnowing machines in use by more prosperous ones. The circular riddle, about 21 inches in diameter, was made of split bamboo strips, bound around the edge with strips of cane. The meshes were about $\frac{3}{16}$ of an inch square. This riddle or sieve was filled with grain and shaken by throwing the contents up in the air. The wind carried off the chaff and the grain dropped back into the shallow basket-like sieve. The winnowing machine used by Chinese farmers is built up between four posts. These posts form the feet upon which the fan rests. The body of the machine consists of two compartments, "separated by a partition with a 13 x 11 inch rectangular opening. One compartment shaped like a drum lying on its side contains the fan wheel with four blades." For the intake of air there were two circular openings, eleven inches in diameter, cut in the sides of the fan compartment. By cranking the fan, "air is blown into the other inside compartment that is open on the left center side, over which a bamboo-woven hood, open at the bottom, is hung up." The draft of air is diverted by the hood into a downward direction. Resting on top of the grain fan is a funnel-shaped wooden hopper the bottom of which ends in a rectangular opening 9 x 2 inches. "The shelled grain passes from the hopper through this and a similar opening coinciding with it, in the top of the grain fan, into the path of the draft. . . The grain passes through the current of air created by the fan, and the light chaff is blown across the inner compartment into the hood hung against the open end of the grain fan, whence it drops down into a basket under the hood. The sound, heavy grains drop down in a straight line directly under the hopper, unaffected by the current of air."[13]

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[3] *Loc. cit.*
[12] Coxe, Tench. *A View of the United States of America.* Philadelphia, 1794.
[9] *Loc. cit.*

A machine for cleaning chaff from grain by a blast of air was, according to Sir Walter Scott as related in one of his novels, against the religious feelings of some of his countrymen, who were shocked by an invention that produced artificial whirlwinds when the weather was calm, and when it was the will of God for the air to be still. They considered it their duty to patiently wait for a natural breeze to separate the chaff from their wheat. The use of such a machine was equivalent to rebelling against God.

In New Jersey during the colonial period grain was cleaned by using a wooden scoop to throw it into the air, thereby allowing it to be winnowed by a current of air. Fanning mills made their appearance at about the time of the Revolutionary War, and were in general use from about the first quarter of the nineteenth century onward, during which time a hand-operated fanning mill was a standard piece of farm machinery wherever grain was produced.

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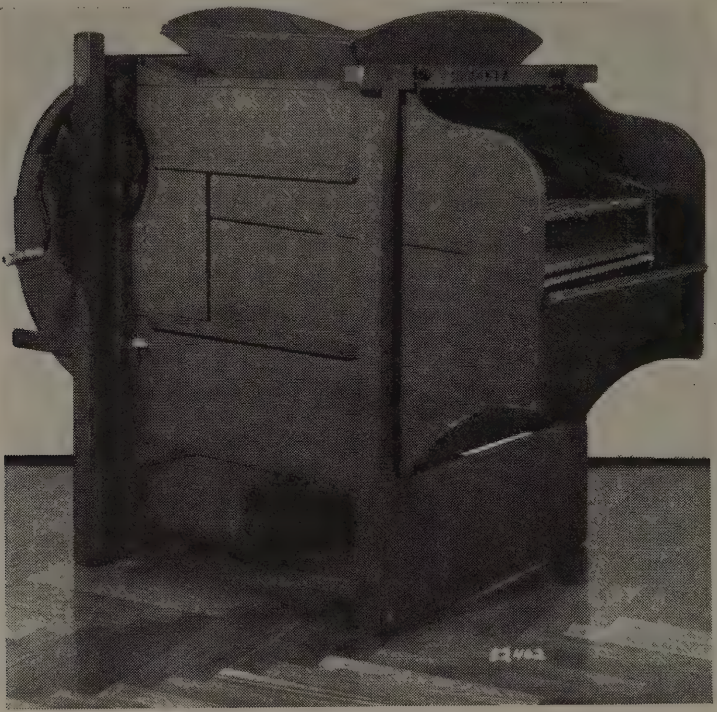
[13] Hommel, Rudolf P. *China at Work.* Doylestown, Pa., 1937.

In 1791, Pierson and Vandevanter, wire manufacturers at 39 Broad Street, New York, made among other things, clover sieves and fan screens. Their advertisement appeared in the April 30, 1791 issue of the "New-York Daily Advertiser." In 1800 a fanning mill was invented in England which used the important features of later machines. It had a rotating fan, a shaking riddle and sieves for sorting the grain and separating unwanted material. The grain accompanied by chaff, dirt, grass-seeds, dust, straw, etc., was subjected to a shaking action on riddles (coarse meshed wire sieves) and sieves in succession during which time an artificial blast of air was driven against the grain on and through the sieves as it fell from one to another. In this way the grain was cleaned.



Type of fanning mill used around 1860.

(Courtesy of The Henry Ford Museum, Dearborn, Michigan)

In 1803 a patent was issued for a machine for cleaning clover, and for a long time the machine was on view in the model room of Peale's Museum in Philadelphia. In "The Centinel of Freedom" for December 22, 1818, Henry Ward of Newark advertised six fanning mills for sale, for cleaning grain, corn, and flaxseed, with four riddles to each mill. Each mill could be carried from place to place by two persons and could be turned by a ten-year-old boy. These machines cleaned better than the old-fashioned ones and were not more than one-third of their size. In 1836 or thereabouts, Robert L. Williams of New York occupied an old shop, once belonging to Pickle's Tannery in Frenchtown Borough, where he built fanning mills. Gordon for 1830 lists a clover mill at Belvidere, one at Knowlton, one at Hackettstown, and one at Marksboro. In 1834 Enoch R. Allen at Allowaystown, and William A. Woolman at Centerton in 1838 had clover mills. In 1840 Barber and Howe reported three clover mills in Morris County and one in Sussex County. These probably were places where there were facilities for cleaning large amounts of seed. According to New Jersey laws of 1834 and 1835, clover mills were to be valued and rated at the discretion of the assessors at any sum not exceeding $8.00.

Mr. Howard R. Kemble found a typewritten manuscript clipped to the Oxford Furnace chapter of Boyer's "Early Forges and Furnaces in New Jersey" at The Camden County Historical Society. In 1876 Col. Charles Scranton wrote of the gristmill as follows: "The grist mill near the old furnace was built in 1813 by Judge Morris Robeson, grandfather of Hon. George M. Robeson, the present Secretary of the Navy. It has been on fire twice in the past 63 years. It had wool carding machinery and clover cleaning works in it." The fire was blamed upon a drunken Negro, a servant to Judge Robeson. Morris Robeson bought the Oxford Furnace properties in 1809 from the Shippen heirs. The grist-clover-carding mill was near the old furnace and could have been the clover mill mentioned by Gordon under Oxford. Under Oxford Furnace, Gordon makes no mention of a clover mill. According to the "New Jersey Mirror and Burlington County Advertiser" of April 11, 1827, the gristmill with its clover-cleaning equipment was burned down on May 25, 1827.

Henry Crocheron of New York City advised the public, in "The True American" (Trenton, N. J.) of June 12, 1809, that he had obtained a patent right from Oliver Barret, Jr., patentee, for making and selling fan mills in New York City, Long Island, Staten Island, and in the counties of Monmouth, Middlesex and Somerset in New Jersey, for use in cleaning all kinds of grain. This mill would clean clover seed from the heads and would take white caps and smut out of wheat. Mr. Crocheron also made and sold rolling, standing and falling screens, sifters for cleaning flaxseed and rice, sand screens, and "ryeing" sieves.

On March 12, 1831 in the "Emporium & True American" (Trenton) John Hutchings of Belvidere advertised for sale the patent right to make and sell Burrel's Patent Clover Mill in the townships of Trenton, Lawrence and Hopewell in Hunterdon County. Similar rights in other townships of the county had been sold, and in most of them the mills were in successful operation. In 1828 Burrel's "improved patent clover machine" was in operation at William Miller's place in Mansfield, Warren County, and also at the mill of John Hutchings at Belvidere. Mr. Miller used horse power, and Mr. Hutchings, water power.

W. Woodford Clayton, in his "History of Union and Middlesex Counties, New Jersey" (Phila., 1882), records a Van Wickles who managed a fanning mill factory at Old Bridge (Middlesex County) about 1835 or 1840, and another fanning mill factory that was established about 1840, also at Old Bridge, by Leonard Applebury and James C. Stout, and that continued until around 1850. T. P. Walworth published a notice "To Farmers" in the "Elizabeth-Town Gazette" of November 28, 1820 stating that country produce would be taken in payment for "Sleigh-Shoes, Fanning-Mill-Wheels, & Waggon-Boxes," at his foundry in "Elizabeth-Town." Also in the "New-Jersey Journal & Elizabeth-Town Gazette" of November 26, 1822, Ogden Woodruff advertised his "Wire, Safe and Fanning-Mill Manufactory" as being located in Water Street opposite the Methodist meeting-house in "Elizabeth-Town." He made wire riddles and sieves for cleaning all kinds of grain, also sieves and screens for gristmills, etc., as well as improved fanning mills, riddles, screens, and wheels for fanning mills.

On Tuesday, March 5, 1833, the clover mill of John Hall near White House was destroyed by fire along with a quantity of toll seed and grain and the work and material of a gristmill nearby ready to be put into operation. The fire caught in some shavings about the stove in the mill, and because of the lack of buckets to supply water from the race, the flames spread rapidly. The loss was placed at about $3,500. This account was reprinted from the "Flemington Gazette" in "The New Jersey Mirror" (Mount Holly) of March 21, 1833.

In the "National Gazette and Literary Register" (Phila.) of January 28, 1823, there was an account of a clover mill erected at Poughkeepsie by a Mr. Bolton. The machinery was simple and the expense trifling. It separated the seed from the chaff, so that none was lost and it left the seed "clean and handsome." This mill was supposed to hasten the time when the farmers of Dutchess County would grow and clean their own seed instead of buying $50,000 worth of seed grown in other parts of the country.

Three fanning mill manufacturers are listed by Kirkbride in his 1850-51 directory. These were Abner Lee, Burlington; Job Allen, Medford, and John Bamborough, Trenton. From the "Gazetteer of the United States" by Thomas Baldwin and J. Thomas (Phila., 1854), we learn that during the year 1849-50, New Jersey was the fifth highest state in clover seed production. During the year ending June 1, 1850, Pennsylvania produced 125,030 bushels; Ohio, 103,197 bushels; New York, 88,222 bushels; Virginia, 29,727 bushels, and New Jersey, 28,280 bushels.

In George De Cou's "Historic Rancocas" (p. 56), he mentions an old mill that once stood on a small tributary of the Rancocas above the Rancocas Fertilizer Works that was established about 1885. About the old mill he wrote "On the 1849 Map at the County Clerk's Office in Mount Holly it is charted as a 'Steam Mill' while in Scott's Atlas, published in 1876, it is called 'Old Mill.' The writer cannot seem to learn when or by whom it was built." The facts about this old mill that eluded historians for years have now come to light through the efforts of Howard R. Kemble, of The Camden County Historical Society, who very generously turned them over to us for inclusion in this account. Mr. Kemble discovered in the "New Jersey Mirror and Burlington County Advertiser" (Mount Holly) for February 22, 1838 a notice of a mill property that was to be put up for sale on March 10, 1838. This mill property, belonging to William A. Woolman, was situated on the south bank of the Rancocas Creek, in Evesham Township, half a mile above Centerton Bridge, adjoining the lands of Israel and Charles Stokes and others and containing about 20 acres. Its improvements consisted of a sawmill, turning mill and clover mill, all in good repair. There was a two-story frame house with seven rooms and a cellar, with a well at the door, and a nearly new barn on the property. "The stream of water which turns the mill is fed by springs, and is therefore steady and unfailing." Apparently the sawmill, turning mill and clover mill were geared to operate from one wheel, and this suggested to Mr. Kemble that the mill was on a tributary flowing into the Rancocas. A visit to the site and a consultation of old maps confirmed this for him. Since 1872 the site has been in Mount Laurel Township.

The fact that Mr. Kemble's grandfather, Samuel Courtney Kemble, was born in Rancocas village in 1840 and as a boy probably explored the mill operations, led him to search through Burlington County records at Mount Holly and he traced deeds for the mill property back to 1802 through names such as William A. Woolman, Eber W. Engle, Isaac Borton, Josiah Lippincott and wife Mary, Richard Borton, Josiah Borton and wife Margaret, and Isaac Borton. Woolman took title March 23, 1833 from Eber W. Engle and had the mill about five years before advertising it for sale. Although the deeds failed to mention "clover mill," this is not strange because the clover mill as such was just a device for cleaning clover seed and a comparatively small piece of apparatus. Primarily the property was a sawmill and the lathe and clover mill were added later.

The new concrete bridge that today carries the New Jersey Turnpike across the Rancocas stands between Centerton bridge and the old clover mill site. An inspection of the old site by Mr. Kemble and Watson Buck led them to the conclusion that it was a natural setting for an overshot wheel. However, in dry spells the tiny spring-fed pond could not be maintained at a level necessary to operate the wheel, and it was apparent that the mill had to be converted to steam. That this was done is clear from the Otley & R. Whiteford wall map of

Burlington County for 1849, which shows a "steam mill' on the site. It still remained a "steam mill" on the 1859 wall map of Burlington County by Kuhn & Janney. In 1860, according to the map of the Vicinity of Philadelphia by D. J. Lake and S. N. Beer, it was a "Saw mill and Foundry" and on J. D. Scott's "Historical Atlas of Burlington County, 1876," it was simply the "Old Mill." Thus ends the account of Mr. Kemble's able detective work.

In nearby Delaware County, Pennsylvania, Enos Painter built a clover mill and a sawmill on Dismal Run, which in 1826 were reported as "old mills." From 1825 to 1831, Thomas Chalfant had charge of these mills, and after 1831 Benjamin Robinson operated the clover mill. The sawmill was run by John Heacock who made pails or buckets, and Hugh Jones who made chair-backs. It was burned about 1860. On the easterly branch of Darby Creek in Radnor, also in Delaware County, Pa., there was in 1826 a clover mill and sawmill owned by William Siter and occupied by William Wilfong, Jr.[14]

In George MacReynold's "Place Names in Bucks County" (Pa.) under Fleecydale, on the Paunnacussing Creek, on the road from Carversville to Lumberville, a fleece or carding mill was built in 1811. In 1834 Philip Fretz operated a clover mill, and the miller offered to clean clover seed for one bushel toll from every 10 bushels cleaned instead of one-eighth as formerly.

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[14] Ashmead, Henry Graham. *History of Delaware County, Pennsylvania.* Phila., 1884.

CHAPTER IV

Tilt Mills, Rolling Mills, Slitting Mills, Etc.

As tilt mills, rolling mills and slitting mills were all involved with the early iron industry of New Jersey, a few introductory remarks about the early furnaces and forges of New Jersey will not be out of place. The terms *furnace* and *forge* were used interchangeably. Smelting, or the extraction of iron from ores, was done in a blast furnace where hard and bog iron ores were reduced to metallic iron. In a blast furnace the operation was conducted in a large pyramidal, truncated, four-sided stack of brick or stone about 20 to 24 feet square at the base, about 20 or more feet high with its top about 16 by 20 feet square. Within this brick or stone structure was a center core made of firebrick or some other refractory material. This core resembled in shape the egg of a hen with the large end down resting on a square fire-bricked chamber called the hearth. The core, which was about 10 feet in diameter at its widest part and 8 feet in diameter at the top, was open at both ends and separated from the brick and stone pyramid which contained it by a lining of sand or broken stone. Three sides of the hearth descended to a hearthstone. On the fourth side was a partial partition of fire brick supported just above the hearthstone. This separated the front and rear parts of the hearth. Arches on each side of the stack extended into the masonry, and through them the air blast pipe extended. In the front arch there were two outlets through which the molten iron and the fused slag were drawn off. After a fire was set on the hearth it was kept going until the stack was heated throughout. Then a small charge of ore, charcoal and a flux of limestone or oyster shells was added in alternate layers and the air blast was turned on. This introduced oxygen which produced intense heat and kept the molten mass agitated. The metal and its impurities separated. The latter rose to the top and the metallic iron sank to the bottom. The slag was drawn off at intervals and the iron was tapped every nine or ten hours from the lower outlet and ran through long channels in the sand known as "sow moulds" and thence into oblong molds in the sand known as "pig" molds. After the iron was drawn off at intervals, new charges were put into the top of the furnace and the process was continued. A blast seldom extended more than 16 or 18 weeks in the early furnaces, as the furnace lining could not withstand the high temperatures beyond that length of time. However, as better heat-resisting materials were found, the blast was lengthened to a period of seven or eight months.[1]

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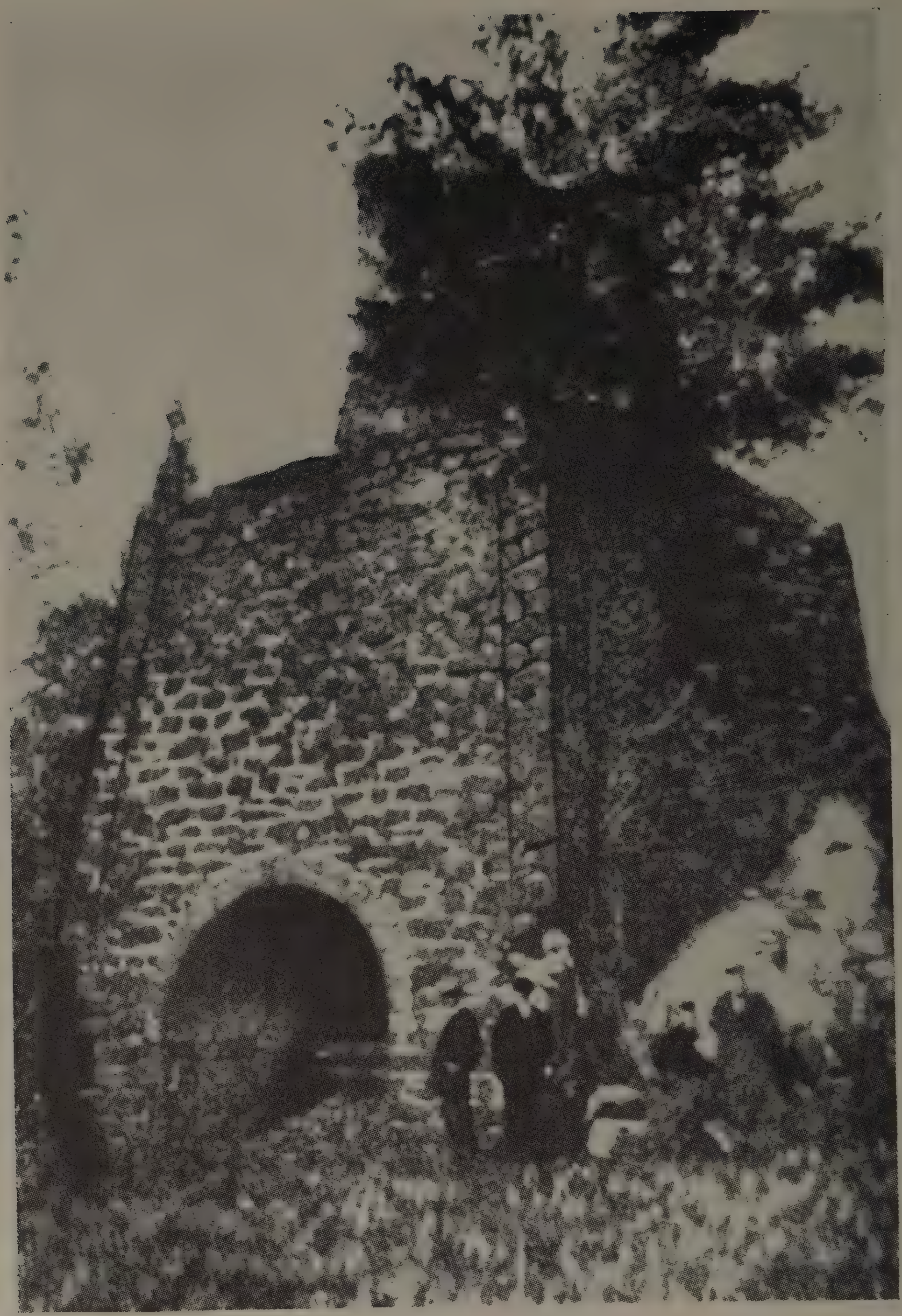
[1] Boyer, Charles S. *Early Forges and Furnaces in New Jersey.* Philadelphia, 1931.



RUINS OF ETNA FURNACE

(From *Early Forges and Furnaces in New Jersey,* by Charles Boyer. (Phila., 1931)

Cazenove, who traveled in New Jersey in 1794 and visited the Boonton Iron Works, had the following to say about the blast: "The forge for making iron is double; a fire and two hammers. Bellows

[are] of new construction, kinds of iron boilers whose lids are pushed by pistons up to the further end, and from there the air passes through tin pipes into an iron pipe which conducts the air into the fire." The pistons were moved by water power and later steam power.[2] Sometimes the blast was supplied by large leather bellows with pipes connecting them with the furnace bottoms.

It was in the bloomery, which consisted of a furnace and forge, where wrought-iron blooms were made, directly from the ore, a bloom consisting of a mass of wrought iron from the forge or puddling furnace (where it was kept at a high temperature) shaped like an oblong block. Or it could be a mass of iron formed by consolidating scrap at a high temperature by hammering or rolling. The hearth was first heated by keeping it two-thirds full of burning charcoal for

HAMMER AT STAFFORD FORGE

(From *Early Forges and Furnaces in New Jersey,* by Charles Boyer. Phila., 1931) four or five hours. The fuel was then pushed against the air-blast inlet and slanted toward the opposite side. Upon this bed of hot coals the ore, flux and charcoal were placed. The air-blast was applied gradually. The charge of iron was worked slowly with a bar so as to permit the current of air to make contact with all parts of the mass. The "loop" as it was called, although largely metallic iron, contained many impurities. This mass was taken out and subjected to heavy blows from a tilt hammer. This got rid of some of the impurities and the iron was wrought into a more regular shape. The partly shaped piece was then put into another forge hearth similar to the first, and when softened by heat but not melted, it was subjected to successive blows of the tilt hammer until it was shaped as required. This forge was known as a "chafery," and its products were mostly long, square, iron bars. Many forges used pig iron as their raw material which they converted into bar iron, and these were sometimes called bloomeries incorrectly.[1]

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[2] Cazenove, Theophile. *Cazenove Journal, 1794,* ed. by Rayner Wickersham Kelsey. The Pennsylvania Historical Press, 1922.

Stamping Mills

Many bloomeries had stamping mills connected with them. These were used to crush the hard ore masses and furnace slag so that the metallic iron could be freed from foreign matter more easily and so that the slag could be run through the furnace again to reclaim its iron. A stamping mill consisted of one or more heavy, iron, drop hammers or stamps operated by a water wheel. In some cases a stamp mill consisted of a row of vertical stamps that were lifted by cams upon a shaft driven by a water wheel or by steam power. The cams were arranged in a spiral series so that the stamps or hammers were lifted consecutively and released to fall upon the ore in a box-like structure. The Ringwood Furnace, Charlotteburg (Passaic County, 1765), had a stamping mill, as did the Martha Furnace (Burlington County, 1805), the Bamber Forge (Ocean County, 1815), the Atsion Forge (Burlington County, 1826), as well as others. The stamping mills were noisy.

Tilt Hammers

The tilt hammer consisted of a 400- to 600-pound iron block fastened to the end of a wooden beam so that it had a free movement up and down. As the end of the beam opposite the hammer engaged cams on the circumference of a water wheel, it gave a tilting motion to the hammer. After the hammer was raised it was allowed to fall by gravity on an anvil placed in a plane parallel with the face of the hammer. The half-molten iron was put on the anvil and under successive blows of the hammer it was pounded into the required size and shape.

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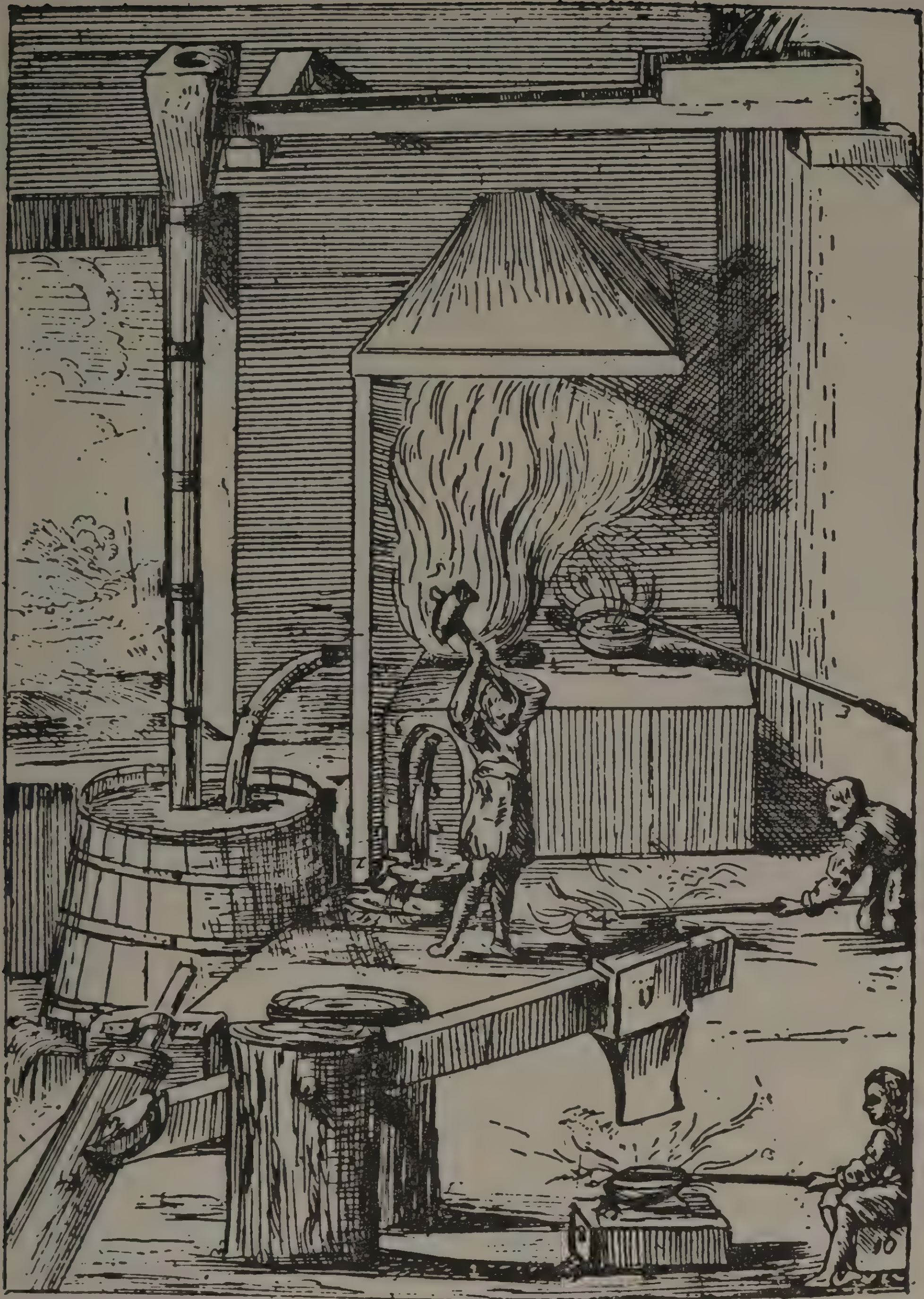
[1] *Loc. cit.*



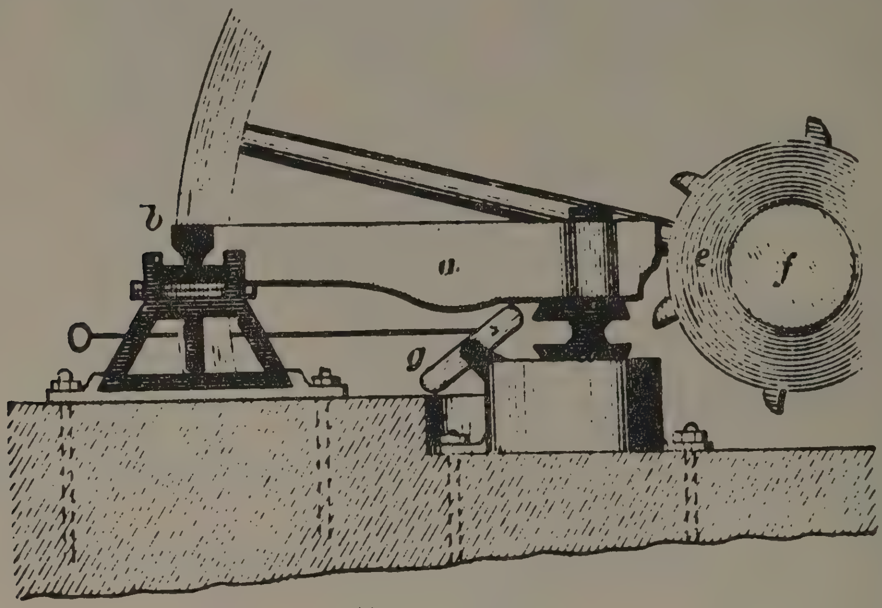
Trompe, used to blow a forge-fire. Tilt-hammer in foreground. 1678.

(From *A History of Technology*. Oxford, 1956)

The Chinese experimented with tilt hammers during the first century B. C., and Europeans, during the fifteenth century. A tilt mill was a building where a tilt hammer was used. The tilt hammer was pivoted as a lever. A wiper wheel with cams or cogs tilted the hammer and then permitted it to fall by gravity upon the bloom on the anvil.

In the sixteenth century in Europe, power-driven tilt hammers were common. The tilt hammer was replaced by the squeezer and steam hammers, and the tilting motion was replaced by a drop movement. Some tilt hammers had a drop of 16 to 24 inches and struck from 75 to 100 blows per minute.[3]

In the Museum of the Bucks County Historical Society, at Doylestown, Pennsylvania, there is a wooden "tilt hammer" used for pounding grain. It consists of a wooden beam about 12 feet long and 6 inches square. One expanded end is hollowed out into a cavity 3 feet 10 inches long, 6½ inches wide and 4¼ inches deep. To the opposite end is affixed a pestle about 20 inches long. The tongue of the pestle fits into the flat end of the beam and the pestle itself extends downward. The pestle is an inverted truncated wooden pyramid with its distal end encased in a metal collar. The pestle extends into a partly hollowed out (burned) tree trunk or mortar about 24 inches high and 12 inches in diameter. The burned out cavity is about 18 inches deep. This wooden tilt hammer was pivoted over a crosspiece at a point where it balanced. When the cavity at one end was filled by a stream of water the pestle-carrying end was raised. When the water spilled out, the pestle end dropped down. It appears to be a rather clumsy and perhaps somewhat inefficient crushing mill.



TILT-HAMMER

Head of wrought iron faced with steel. Head raised by series of cams on cast-iron collar *e* fixed on shaft *f*, which is provided with a heavy fly-wheel. Hammer has a drop of 16 to 24 inches and strikes 75 to 100 blows per minute.

(From *Knight's American Mechanical Dictionary.* Boston, 1876)

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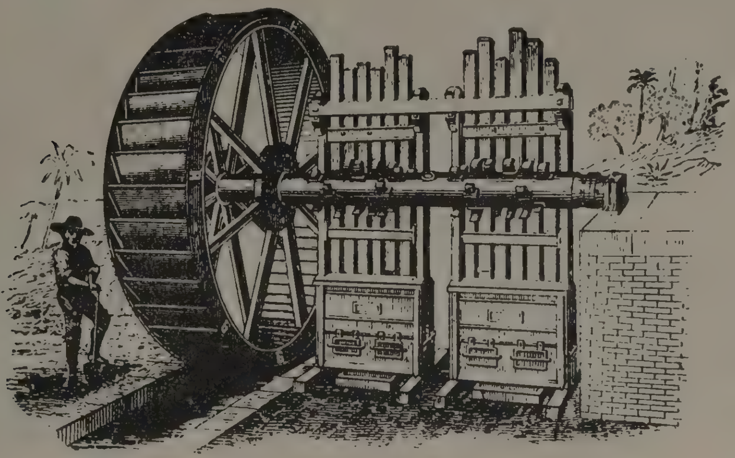
[3] Knight, Edward H. *American Mechanical Dictionary.* Boston, 1876. Boyer, Charles S. *Early Forges and Furnaces in New Jersey.* Phila., 1931.

At the Howell Works in Monmouth County there was a tilt or trip hammer, according to the "Trenton Federalist" of March 3, 1817, in which the property was offered for sale. All forges had one or more hammers, but their advertising seldom mentioned the type, as one type was in common use.

Rolling Mills and Slitting Mills

Mills for rolling and slitting metal developed in Europe during the Middle Ages, but it was not until around 1750 that they were made strong enough to produce good sheet iron. After their invention during the Middle Ages their number increased rapidly during the sixteenth century and their use spread to many countries. Rolling is the method of forming metal into plates, rods and bars, wagon tires, etc., by drawing it between cylindrical rollers that are either plane or grooved to suit the shape that is needed. Iron is rolled when it is red hot, and the rolling compresses the metal and knits its fibers together. Rolls are journaled in pairs. When grooved they are made so as to act together in pressing the heated iron, passing between them, to the required shape. The face of each roll is equipped with a series of grooves. These gradually decrease in size toward one end and the iron is put through each, in succession. This gradually reduces its size and increases its length. The plates from which nail rods were made were about six inches wide.

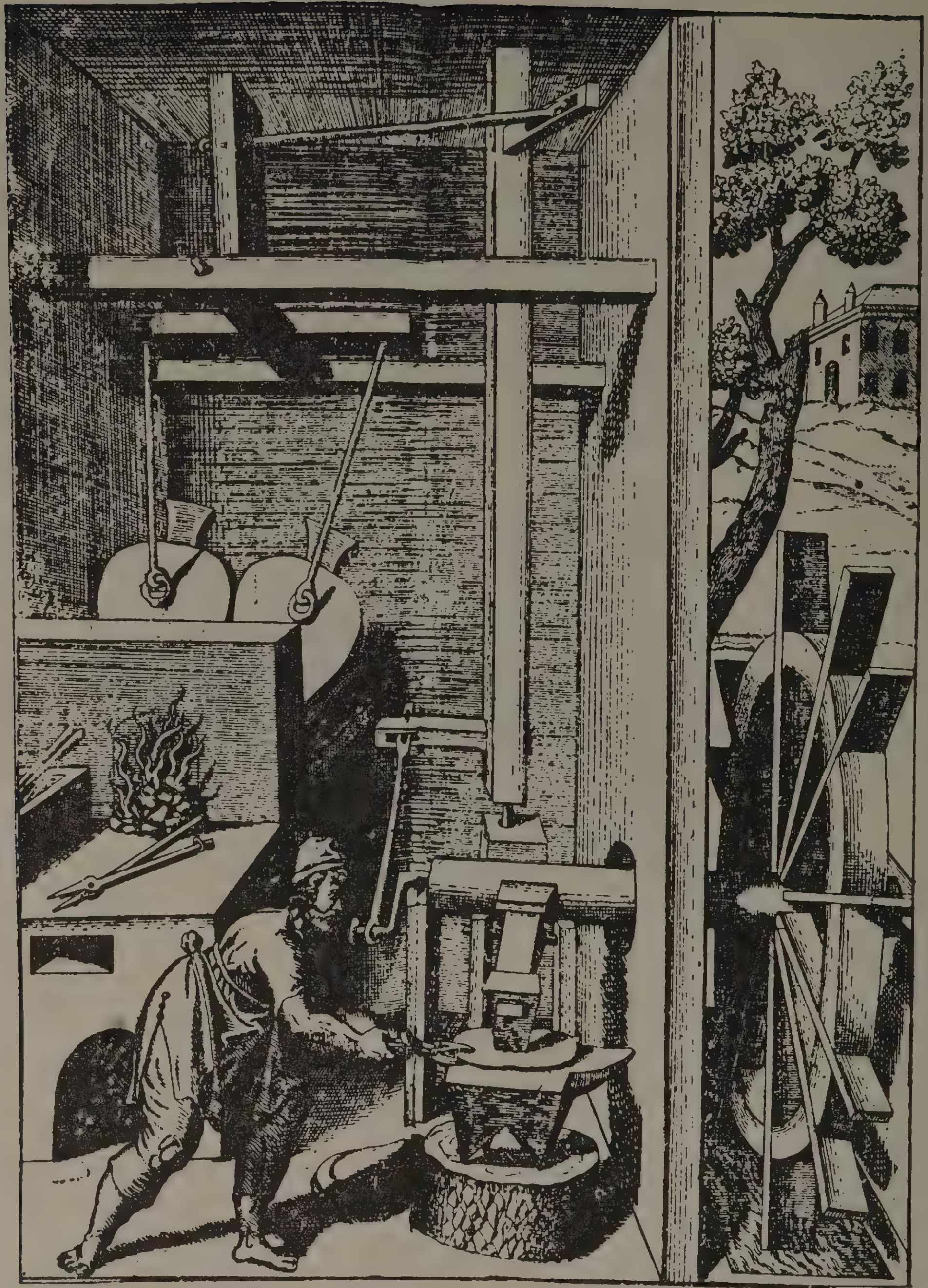


Stamp Mill

Mortars arranged in a row beneath the stamps which slide in guide-bars as they are alternately lifted by wipers on horizontal shaft of water wheel. At each revolution of the shaft each stamp makes two blows.

(From *Knight's American Mechanical Dictionary.* Boston, 1876)

In 1750 the English Parliament passed an act compelling her American colonies to send their crude iron to Great Britain and to



WATER-DRIVEN HAMMER FORGE. STRADA, 1617

(From *A History of Technology.* Oxford, 1956)

receive from foreign sources the nails, steel and finished products which they had been manufacturing at home. This selfish policy was for the benefit of a few shipping and other interests in England, and it served to increase costs and stifle the colonial manufacture of iron.

Governor J. Belcher on September 15, 1750 signed the following: "A Proclamation. Having received His Majesty's Commands, to cause the Act for encouraging the Importation of Pig and Bar Iron from his Majesty's Colonies in America; and to prevent Erection of any Mill or other Engine for slitting or rolling of Iron, or any plating Forge to work with a Tilt-Hammer, or any Furnace for making Steel, in any of the said Colonies, and every Clause therein to be strictly and punctually observed within this Province," in which he required the owner of every mill or engine for slitting or rolling iron and every forge that worked with a tilt hammer and every steel-making furnace which was erected before June 24 last to deliver to the Secretary's office at Burlington on or before October 20 next, a particular account of their works and the names of the owners and whether the works was being operated. The sheriffs of the several counties were required to notify Governor Belcher before October 20 of the number of mills as described and the names of their owners.[4] The penalty for violation of the 1750 act was a fine of 200 pounds.

Governor Belcher, on November 10, 1750, in a letter from Burlington to the Duke of Bedford certified that there was one mill or engine for slitting in Bethlehem Township, Hunterdon County, on the South Branch of the Raritan River on the property of Messrs. William Allen and Joseph Turner of Philadelphia which was not in use. This was the Union Iron Works at High Bridge. There was also one plating forge with a tilt hammer situated on a small brook at the west end of Trenton, Hunterdon County, the property of Benjamin Yard. This was in operation. In addition there was one furnace for making steel in Trenton, the property of Benjamin Yard, but this was not in use. All had been built before June 24 last. Nothing else was found in the province of New Jersey.[5]

In defiance of the law, Samuel Ogden, of Newark, built with the help of his father a slitting mill on the Rockaway River about a mile below Boonton. The entrance was from a hillside. In the upper room where one entered there were facilities for grinding grain, but the slitting mill was out of sight below. It was said that Governor William Franklin visited the place suddenly, having heard a rumor about the existence of a slitting mill, but he was so well entertained by Mr. Ogden that he departed saying that he was pleased to find the rumor groundless.[5]

Governor Franklin in 1768 reported eight blast furnaces in the New Jersey Colony for making pig iron and 42 forges for the manufacture of bar iron. There were also a slitting mill, a steel furnace and one plating mill. The steel furnace had been nearly idle for several years, and at the slitting mill and plating mill nothing had been "carried on with Vigor." In spite of the attempts of Great Britain,

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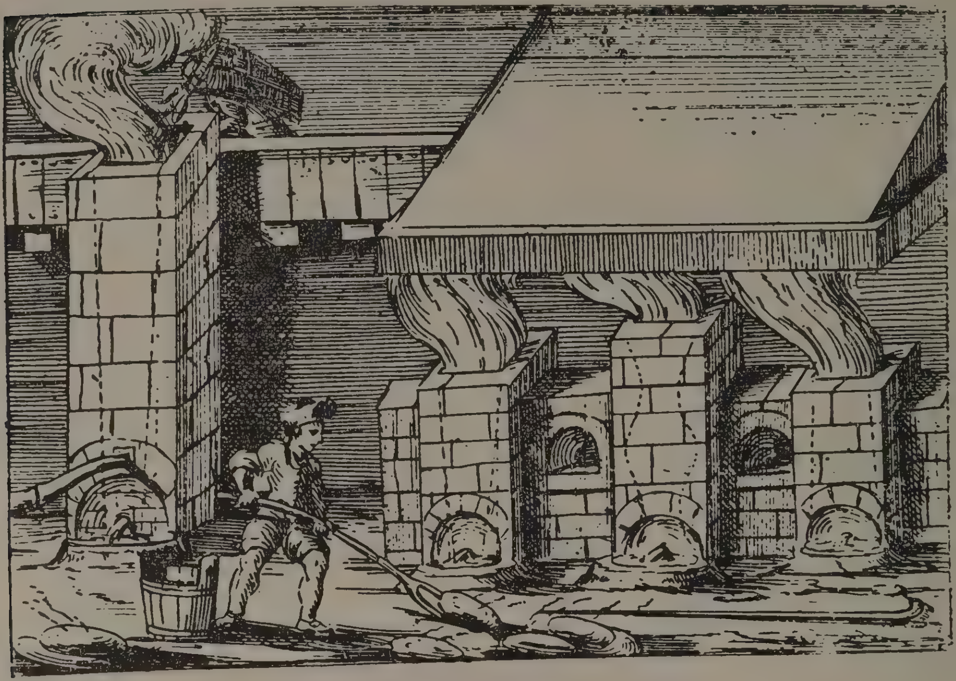
[4] "The New-York Evening Post." Sept. 24, 1750.
[5] *New Jersey Archives,* Vol. VII, pp. 554-570.

An iron bar being forged on an eighteenth century French forge.

(From *Diderot's Encyclopaedia,* 1751-1780)



ITALIAN SMELTING-FURNACE, 1678

(From *A History of Technology.* Oxford, 1956)

however, to suppress iron manufacturing, there were many little iron forges in the Province.[1]

The Andover Furnace in Sussex County had a slitting mill, this being mentioned in the "Pennsylvania Gazette" of October 4, 1770, where the forge and slitting mill were offered for rent with or without a furnace by Allen and Turner. Another slitting mill is recorded in "The New-Jersey Journal" of March 29, 1780 offering for sale, in order to satisfy a judgment, one-third part of the slitting mill at Boonton formerly the property of Nicholas Hoffman and Isaac Ogden. In 1787 Peter T. Curtenius & Co. of 48 Great Dock Street, New York, made rollers and shears for slitting mills. Their firm was known as the New York Air Furnace. By 1794 New Jersey rolling and slitting mills were producing 80 tons of nail rods yearly.

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[1] *Loc. cit.*

The Wading River Forge and Slitting Mill was built by Isaac Potts, an iron master of Philadelphia in 1795, at Harrisville, New Jersey. This forge and slitting mill purchased its iron from Martha Furnace, which Isaac Potts built. It opened in 1793 and closed in the 1840's. In 1827 the Dover Iron Works in Morris County had three rolling mills. In "The Jerseyman" of September 12, 1827, the Dover works advertised among other items cut nails of all sizes, spikes and horse nail rods. Paterson in 1829 had a rolling and slitting mill, and a nail factory which made 672,000 pounds of nails, according to Bishop. There was a slitting mill at the works of Jacob Arnold and John Kinney at Speedwell, Morris County, in 1776, although their venture was a failure. In the "Pennsylvania Gazette" of October 4, 1770 in a notice putting up the Union Iron Works and High Bridge Forge for rent, mention is made of a slitting mill.

Israel Canfield and Jacob Losey entered into a partnership at Dover, in Morris County, in 1793 under the firm name of Israel Canfield & Co. They opened a store and had a slitting mill and forge. Their advertisement in "The New-Jersey Journal" of March 20, 1793 calls attention to their stock of nail rods to be sold for cash or bartered for pig iron. It also said that bar iron would be received and slit into any kind of nail, deck, or spike rods.

According to the Federal Census of 1810, there were three rolling and slitting mills in New Jersey, one in Burlington County and two in Morris County. Two hundred tons were rolled and slit in Burlington County, and 650 tons in Morris County. The value of the Burlington County output was $30,000. The same census reported six trip hammers in the State, two in Morris County with the product valued at $12,200, and four trip hammers in Cumberland County with a product valued at $36,000.

In Thomas F. Gordon's "Gazetteer of the State of New Jersey," Trenton, 1834, figures gathered by county assessors showed 13 rolling and slitting mills in New Jersey in 1830. These were distributed as follows among the counties: Cumberland, 1; Essex, 3; Morris, 9.

In 1841 the "Compendium of the Sixth Census of the United States" recorded 80 bloomeries, forges and rolling mills that made bar iron in New Jersey in 1840. Their distribution and tonnages were as follows:

County	No. bloomeries, forges, rolling mills	Bar iron produced (tons)
Atlantic	2	80
Burlington	1	35
Cumberland	1	...
Monmouth	2	29
Morris	43	5,976
Passaic	18	505
Sussex	13	546
Totals	80	7,171

The 7th Census of the United States for 1850 reported that iron rolling mills in New Jersey employed 84 males, that iron forges, foundries, rolling mills, etc., employed 2,681 males, and nail manufacturers numbered 126.

In 1860, according to Bishop, there were ten rolling mills in New Jersey, which are listed as follows:[6]

ROLLING MILLS IN NEW JERSEY IN 1860
(Dates refer to time mills were built)

Boonton. Fuller, Lord & Co. 1825.
Bridgeton. Cumberland Iron Co. 1824.
Charlottesburg. Geo. H. Renton. 1840. (In Pompton Twp., Bergen Co.)
Dover. Henry McFarland. 1838.
Jersey City. Chrisman & Co. 1852.
Jersey City. Chrisman & Durben. 1857.
Pompton. Charles A. Richter. 1838. (near Rockaway.)
Powerville. T. C. Willis. 1846. (Morris Co.)
Rockaway. Rockaway Iron Co. 1855.
South Trenton. Cooper, Hewitt & Co. 1845.

In "Manufactures of the United States in 1860," published at Washington, D. C., in 1865, two firms in Burlington County manufacturing bar iron, etc., had capital invested amounting to $24,900; the cost of their raw material was $19,600; they employed 15 hands, and the yearly cost of their labor was $6,300; the annual value of their products was $36,200. Two similar establishments in Hudson County had a capital investment of $80,000; the cost of their raw material was $103,800; they employed 54 hands; their annual cost of labor was $19,800; the annual value of their products was $170,000.

TAXES

Taxes on rolling and slitting mills, forges, etc., varied from time to time. In 1778 all rolling and slitting mills were rated at the discretion of assessors not under 10 pounds nor above 30 pounds. All forges that worked pig iron and all forges and bloomeries that made bar iron immediately from the ore were to be rated at not under 30 shillings nor above 10 pounds for each fire. In 1783 all forges that worked pig iron and all forges and bloomeries that produced bar iron immediately from the ore were rated at any sum not over 40 shillings for each fire. All rolling and slitting mills were rated at any sum not over 15 pounds. In 1785 the rates were as follows: all rolling and slitting mills—not over 6 pounds, 5 shillings; all furnaces—not over 3 pounds, 5 shillings; all forges working pig iron and bloomeries working bar iron from ore—not over 20 shillings for each fire.

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[6] Bishop, J. Leander. *A History of American Manufactures, 1608-1860,* Vol. II, Phila., 1864.

For a few succeeding years the rates were as follows:

1786. All furnaces, any sum not over 3 pounds, 5 shillings.
All forges (as formerly), not over 25 shillings for each fire.
All rolling and slitting mills, any sum not over 6 pounds, 5 shillings.
1787. All furnaces, not over 1 pound, 5 shillings.
All forges (as formerly), not over 10 shillings per fire.
All rolling and slitting mills, not over 2 pounds. 10 shillings.
1790. All furnaces, not over 3 pounds.
All forges (as formerly), not over 40 shillings for each fire.
Rolling and slitting mills not mentioned.
1794. All furnaces, not over 4 pounds, 10 shillings.
All forges (as formerly), not over 25 shillings per fire.
Rolling and slitting mills not mentioned.

In 1794, according to the "Votes and Proceedings of the General Assembly of the State of New Jersey," an estimate of the rateables in the state was taken by the Legislature, which included furnaces and forges, as follows. The yearly changes in taxes were due to the different sums required each year by the state government.

ESTIMATE OF RATEABLES, 1794

	FURNACES		FORGES	
County	No.	Valued at 250 pounds	No.	Valued at 75 pounds
Bergen	1	250 pounds	6	450 pounds
Monmouth	..	...	13	975 pounds
Somerset	..	...	2	150 pounds
Burlington	5	1,250 pounds	12	900 pounds
Salem	1	250 pounds	1	75 pounds
Morris	2	500 pounds	54	4,050 pounds
Sussex	2	500 pounds	31	2,325 pounds
Totals	11	2,750 pounds	119	8,925 pounds

The committee appointed to settle the quotas of taxes to be paid by the various counties made a report to the General Assembly on November 15, 1822, which was accompanied by a schedule "supposing the total sum to be raised to be $20,000." For forges, furnaces, rolling and slitting mills, the number of such items and their taxes are shown in the following table.

TAXES, 1822

	FURNACES		FORGES		ROLLING AND SLITTING MILLS	
County	No.	Tax $200	No.	Tax $40	No.	Tax $50
Bergen	1	200	11	440	..	..
Burlington ...	4	800	4	160	..	..
Cumberland ..	2	400	1	40	1	50
Essex	..	...	..	...	1	50
Gloucester ...	2	400	2	80	..	..
Monmouth ...	..	...	2	80	..	..
Morris	1	200	53	2,120	1	50
Somerset	..	...	1	40	..	..
Sussex	..	...	22	880	..	..

CHAPTER V

Nails and Screws

NAIL MAKING

From very early times iron nails were hand forged on an anvil by a blacksmith who hammered them out, pointed them, cut them to the required length and wedged them into an iron hole one at a time where a head was hammered on. Ancient Egyptian nails were usually made of bronze. These hand-forged nails were not thrown about carelessly, but were carefully hoarded as they were expensive to make. This was the common way of making nails previous to the introduction of machinery. The heads and points of the wrought nails varied, but the shanks formed from nail rods were rectangular and hand hammered to a taper on all four sides if a point was wanted. New Jersey colonial and later farmers often made their own nails from scraps of iron on a home forge if nail rods were not available. They also made their own spikes and large nails. During the winter months when outside farm work was impossible, many farmers, including their children, would make nails from rods obtained at the slitting mills. Nails were sold or exchanged for other necessary articles. The nail rod used by the blacksmith and farmer was a rectangular strip of forged iron that was soft and malleable. It was about ¼ of an inch thick and several feet long. It came from a slitting mill where the iron had been rolled out into thin rods from large bars. These were sometimes cut by a cold chisel into lengths of about 2¼ inches. The chisel tapered them at the same time. For small nails the iron did not require heating. Later, nail rods were sold at village stores. After the nail was cut it was sometimes slit at the top and then hammered so as to form a head. In making wrought nails, the blacksmith or nailer heated the end of a nail rod in his forge and then on the anvil pointed it on all four sides with a hammer. Next the rod was partly cut with a hammer blow and the hot end was inserted in the hole of a heading tool. The rod was then broken off leaving the nail in the heading tool with its end projecting. This projecting end was hammered down and spread around the top of the hole. Then the cooling shrunken nail was knocked out of the heading tool. This tool was a short iron bar with a square bottom-expanding hole at both ends. For rivets the holes were circular. While being used it was held in the left hand of the nailer.[1]

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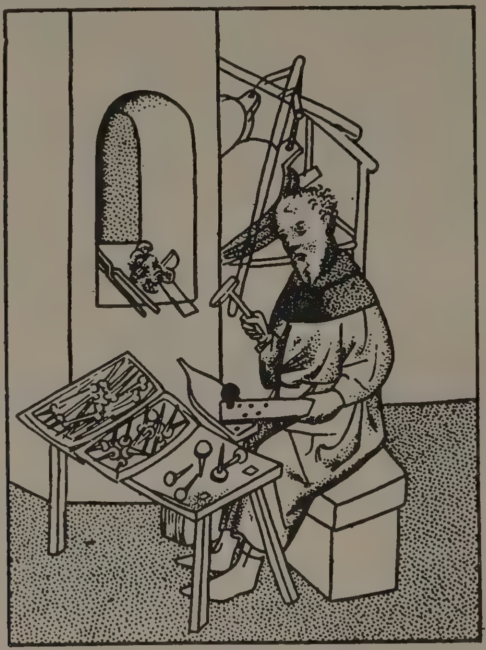
[1] Mercer, Henry C. *Ancient Carpenters' Tools.* Doylestown, Pa., 1929. Rawson, Marion Nicholl. *Handwrought Ancestors.* New York, 1936.

Horse-shoe nails were made by blacksmiths. In order to form one, a blacksmith had to give some 20 hammer blows and could not make more than ten or twelve pounds during a day. In 1850 Silas S. Putnam of Neponset, Massachusetts, perfected a machine to make such nails, but it was some years before the public recognized them as being satisfactory.

In Newark, New Jersey, nails were used as early as 1668, as an item in the town "Minute" book for that year records the sale of a town lot to Henry Lyon for 10 pounds, three pounds of which were to be paid in shingle nails. Another item in the same book for 1669 directs each settler to pay his assessment of nails for closing in the meeting house to "Brother John Brownes as soon as he can."



Late fifteenth century German nail-maker. Metal was hammered through a graded series of holes and became a primitive type of nail.

(From *A History of Technology.* Oxford, 1956)

In letters from early settlers in the new world to prospective settlers of the old, there was definite advice upon what to bring to America in the way of cloth, leather, tools, etc., including, of course, nails. Sometimes the advice was to bring raw materials. This is indicated in the following excerpt from a letter from Mr. Higginson to friends at Leicester, England, written in September, 1629. "Therefore be sure to furnish yourselves with things fitting to be had, before you come, as meal for bread, malt for drink, woolen and linen cloth, and leather for shoes, and all manner of carpenter's tools, and a good deal of iron and steel to make nails, and locks for houses, and furniture for plows and carts. . ."[2] Large quantities of nails were subsequently imported from England. In an account from John Norton & Sons, merchants of London and Virginia, dated London, February 22, 1766, it was stated, "Yesterday a very considerable body of Merchants concerned in the American and West Indies trade attended the House. . . It is said one Merchant has declared that he has sent to the value of 50,000£ in the single article of nails per annum for several years to America, and that by countermanding this Article he has at present 300 men out of business."[3] Before the invention of machinery large numbers of persons were employed in making nails. In the neighborhood of Birmingham (England) alone there were no fewer than 60,000 nailers.[4] In another letter from John Norton and Sons, dated London, April 4, 1767, appeared the following interesting statement, "Would you believe it? At this juncture, when these people (Americans) are complaining of the want of cash to pay their old debts, they have sent over orders, yes, and money with the orders, for greater quantities of nails of all kinds for building than was ever known before: And it is impossible to execute the orders that have been sent, for many months to come. Now, preparations for building are signs of wealth in Europe; but it seems they are signs of poverty, or want of cash, in America."[3]

Adam Smith in his "Wealth of Nations" (1776), wrote of nail making as follows:

"A common smith, who, though accustomed to handle the hammer, has never been used to make nails, if on some particular occasion he is obliged to attempt it, will scarce, I am assured, be able to make above two or three hundred nails in a day, and those too very bad ones. A smith who has been accustomed to make nails, but whose sole or principal business has not been that of a nailer, can seldom with his utmost diligence make more than eight hundred or a thousand nails in a day. I have seen several boys under twenty years of age who had never exercised any other trade but that of making nails, and who, when they exerted themselves, could make, each of them, upwards of two thousand three hundred nails in a day. The making of a nail, however, is by no means one of the simplest operations. The same person blows the bellows, stirs or mends the fire as there is occasion, heats the iron, and forges every part of the nail: In forging the head too he is obliged to change his tools."

During the first Congress in 1789, the House of Representatives, as a committee of the whole, discussing a bill to impose duties on imports, covered nails, spikes and brads. Mr. Bland of Virginia was not in favor of a duty on nails because it would burden the southern states but not the northern states who made their own nails. Mr. Goodhue of Massachusetts advised the gentlemen from the south that in Pennsylvania and Massachusetts large quantities were manufactured for export, and he thought that in a little time enough might be made to supply all North America. Mr. Ames of Massachusetts spoke of the country people who had small forges in their chimney corners and of the large quantities of nails made during winter evenings, even by children. He wanted nails to remain in the bill. Mr. Sherman of Connecticut thought that every state could eventually make all the nails to supply their needs and that it would not be amiss for the government to get some revenue from the consumption of foreign nails. Mr. Tucker of South Carolina did not think the nail industry required legislative assistance. And so the discussion continued. It was finally decided that nails and spikes should pay a duty of one cent per pound and that tacks and brads were to be struck out.

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[2] Young, Alexander, ed. *Chronicles of the First Planters of Massachusetts Bay, Collected from Original Records and Contemporaneous Manuscripts.* Boston, 1846.

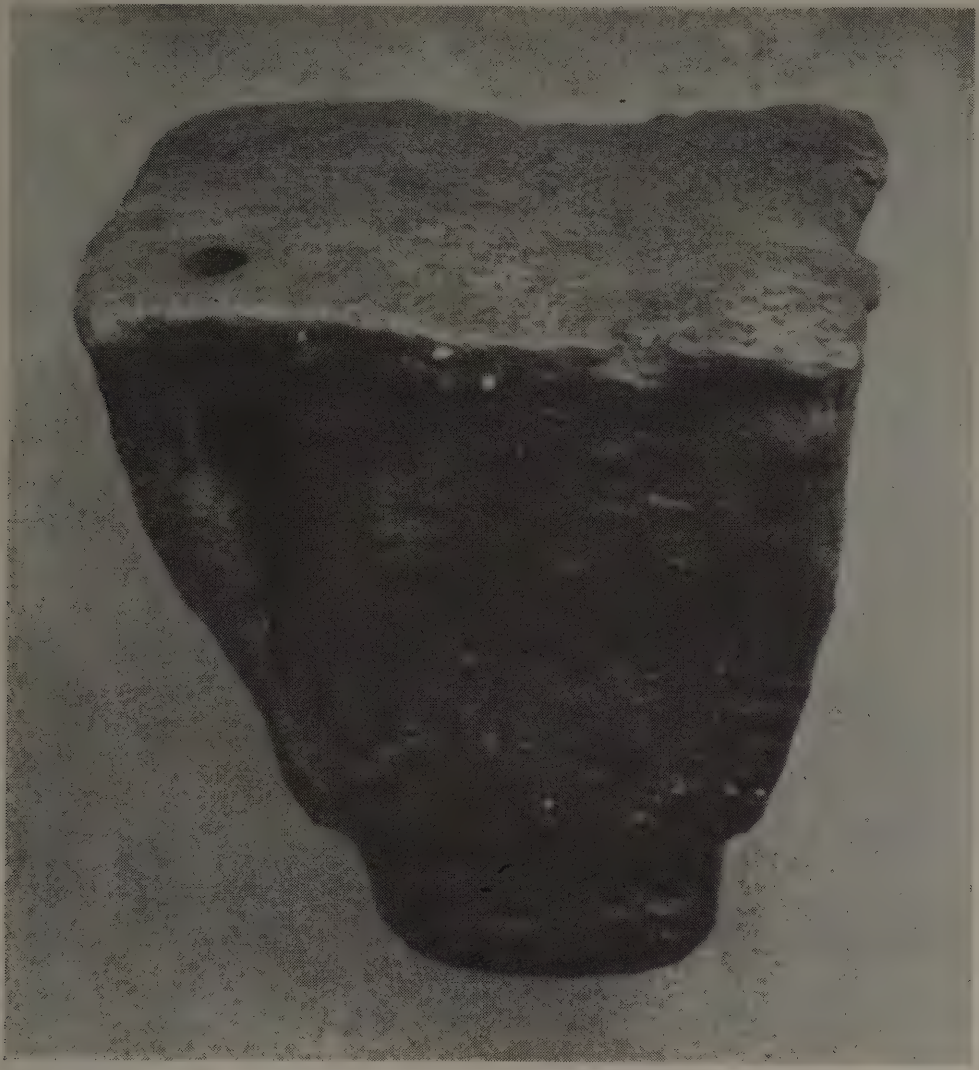
[3] "John Norton & Sons, Merchants of London and Virginia." Virginia Gazette, 1937, p. 13.

[4] *American Cyclopaedia.* New York, 1885, XII, pp. 125-126.

In De Montlezun's book, "Voyage fait dans les annees 1816 et 1817 de New Yorck a la Nouvelle-Orleans et l'Orenoque au Mississippi" 1818, (p. 126), it is stated that, at Monticello, Thomas Jefferson had some 11,000 acres of which 1,500 were under cultivation, and that in addition Mr. Jefferson owned land in Bedford County on which he grew tobacco and grain. He also had sheep, a cotton and wool factory, and a nail works, the location of which was not specified.

An Englishman named Thomas Clifford in 1790 patented a method of making nails by shaping them in a groove between rollers whose depressions agreed with the shape of the nail, half in each roller. The heads and tails were joined so as to form a string of nails that could be cut apart later. Clifford's patent was followed by 30 or 40 more English patents. However, the American nail-cutting machine was the first to cut the nails and shape the heads in one operation.

After about 1800 the wrought nail was displaced by the cut nail, which was more easily made. The blacksmith was supplied, not with a nail rod but with a strip of iron plate about ⅛ of an inch thick, 2¾ inches wide and several feet long. This was slid into a cutter resembling the cutter in use by bookbinders to trim books, and this cutter, operating up and down with a rapid motion, clipped off the end of the iron plate crosswise into narrow, tapering, slices or nails. The cutters at first were worked by hand. The taper of the cut provided the nail with a point but not a head, and so at first the newly cut nail was put into a slotted vise and the projecting end was spread into a head by hammering it. Both wrought and cut nails had rectangular shanks. The wrought nail tapered on all four sides. The cut nail tapered on two opposing sides only. Mercer has stated that cut nails, between about 1800 and 1825, with hammered heads show evidence of more than one hammer blow. Those after about 1825 and through the following 100 years, with stamped heads, show level tops impressed by a single stamp or blow. This indicated imperfect nail-cutting machines up to 1825, and after 1825 nail machinery that produced cut nails in one operation. The nail machines were eventually operated by water power instead of by hand.[1]



ROMAN NAIL-HEADING ANVIL

Circular nail hole at left, with deep cavity underneath for release of nail. Original in Museum at Speyer.

(From *Ancient Carpenters' Tools,* by Henry C. Mercer, Doylestown, Pa., 1929)

Jeremiah Wilkinson, Cumberland, R. I., around 1775 cut tacks from sheet metal plates and later also made nails, and Ezekiel Reed [Rud] of Bridgewater, Mass., in 1786 invented a machine for cutting nails from plates. Two years later he got a patent for cutting and heading

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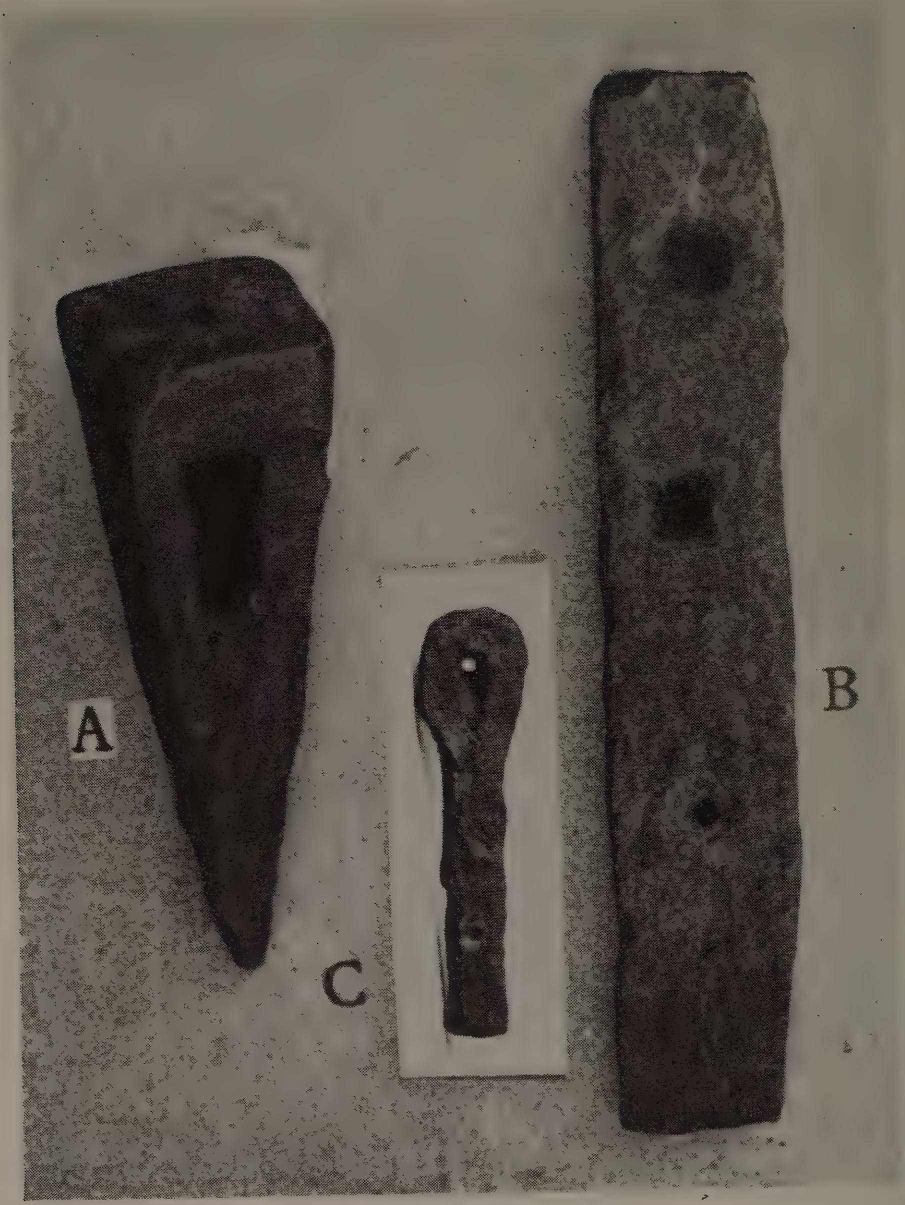
[1] *Loc. cit.*



Roman Nail-Heading Tools

A. Small, wrought iron anvil-wedge 4¾ inches high, with square nail hole. B. Flat wrought iron bar, 6¾ inches long, with 3 square nail holes. C. Wrought iron bar, 4¾ inches long, with single nail hole.

(From *Ancient Carpenters' Tools,* by Henry C. Mercer)

them in one operation.[5] In 1790 Jacob Perkins of Newburyport, Massachusetts, invented a machine for making cut nails, and patented a machine to cut and head nails in one operation in 1795.[6] A nail-making machine was invented by J. G. Pierson of New York in 1795 and during the next year eleven patents were granted on machines to manufacture nails, brads and tacks. In Amesbury, Massachusetts, in 1798 the first mass-production nail factory was established. In 1805 it was incorporated with a capital of $450,000. Jesse Reed of Boston got a patent in 1807 on a nail machine and by 1809 twenty-two of his machines were in operation at Malden, Massachusetts. His 1798 hand-cranked machine for cutting and heading nails in one operation did not work successfully. There was a ten-machine nail factory at Chester Creek, Pennsylvania, and a twenty-machine one at Phoenixville, Pennsylvania. These 52 machines produced 3,000,000 pounds of nails yearly. By 1810 there were 410 nail factories turning out 15,000,000 pounds of nails annually. Between 1790 and 1825 there were 120 patents issued on machines to cut nails, brads and tacks.[7] Jesse Reed's machine was widely used. In 1739 Edward Jackson of Boston offered for sale in the "Boston Gazette" of February 26/March 5, "Sundry sorts of Nailer's Tools, as Bellows, Stakes, Hammers and Nail-Tools." A model of a nail-cutting machine, invented by a Nathan Read, is in the Essex Institute, Salem, Massachusetts.

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[5] *Knight's American Mechanical Dictionary.* Boston, 1872.
[6] Bishop, J. L. *A History of American Manufactures, 1608-1860.* Phila., 1868.

The citizens of Morris, Sussex and Bergen counties, New Jersey, on March 30, 1802, adopted a memorial, signed by John Cobb as chairman, at a public meeting. This memorial, that was sent to Congress, called attention to the fact that they were engaged in the manufacture of bar, cast, and rolled iron, nail rods and nails, and they asked for an increase in the duties on imported iron. This was accompanied by a statement of the number of forges, furnaces, etc., in the state. There were four rolling and slitting mills which rolled and slit on an average 200 tons, one half of which was made into nails. About 1890 the nail industry was revolutionized by the introduction from Europe of the round-shanked, clenchable, machine-made wire nail.

The advantages of cut nails over wrought ones were soon brought to the attention of builders and the public in general. Josiah G. Pierson of New York City advertised in "The Diary" of July 11, 1796 that he had in operation his "newly-invented machines for manufacturing Floor Brads of different sizes, from 8d to 24d. They are cut with a head complete, and are found superior to wrought ones for the following reasons: That they will drive into more solid timber, are not so liable to split the board, will hold more firm, require no flattening of head, are sold for less per lb. and a number more in a lb. they being much slimmer and lighter than wrought ones. . ."

The "Scientific American" of April 21, 1848, stated that cut nails did not clinch like the wrought ones, but for some purposes they were better. The cut nails needed no gimlet holes and a carpenter could

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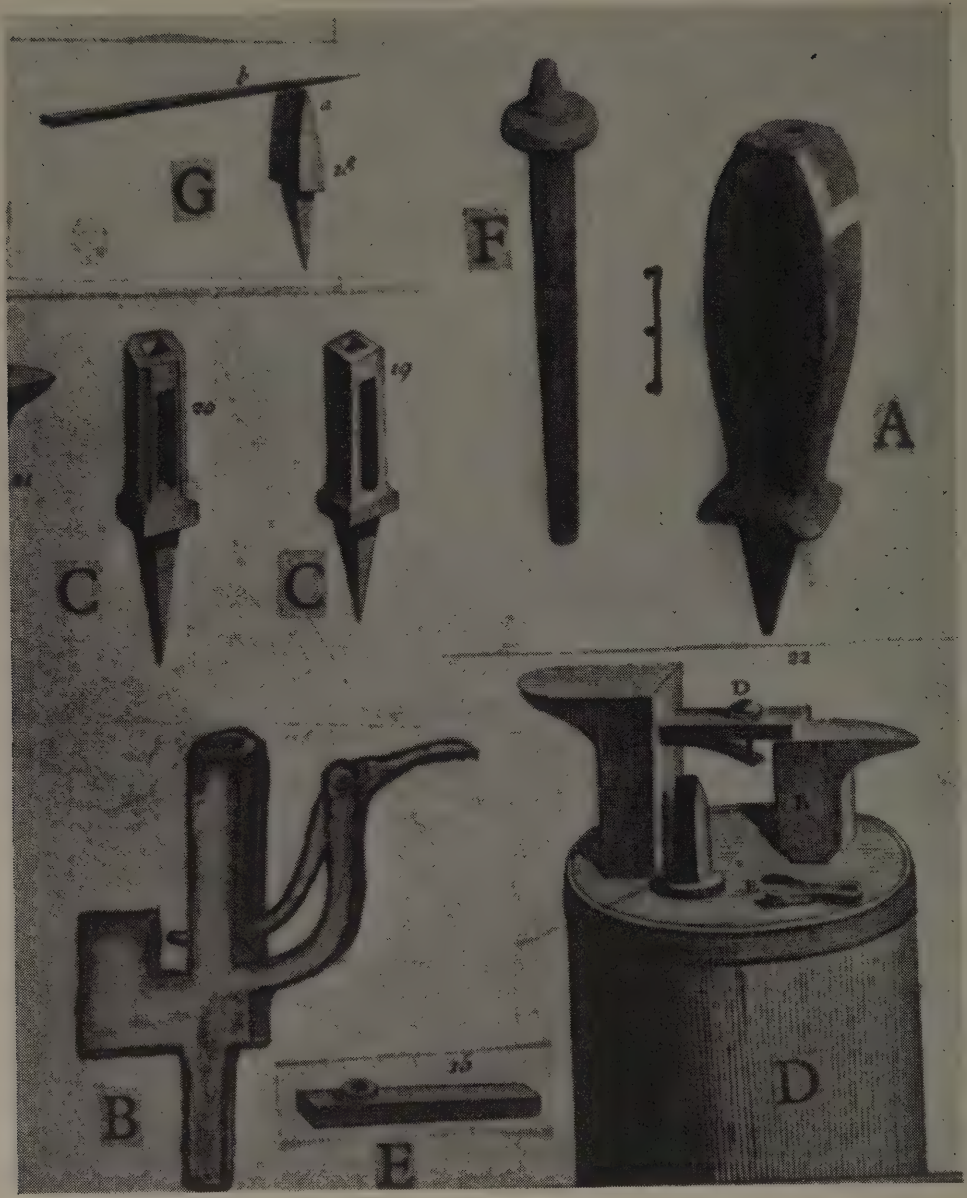
[7] Drepperd, Carl. "Spikes, Nails, Tacks, Brads and Pins," Chron. Early Amer. Ind. Assoc. Vol. III, No. 8, p. 69. Aug., 1946.

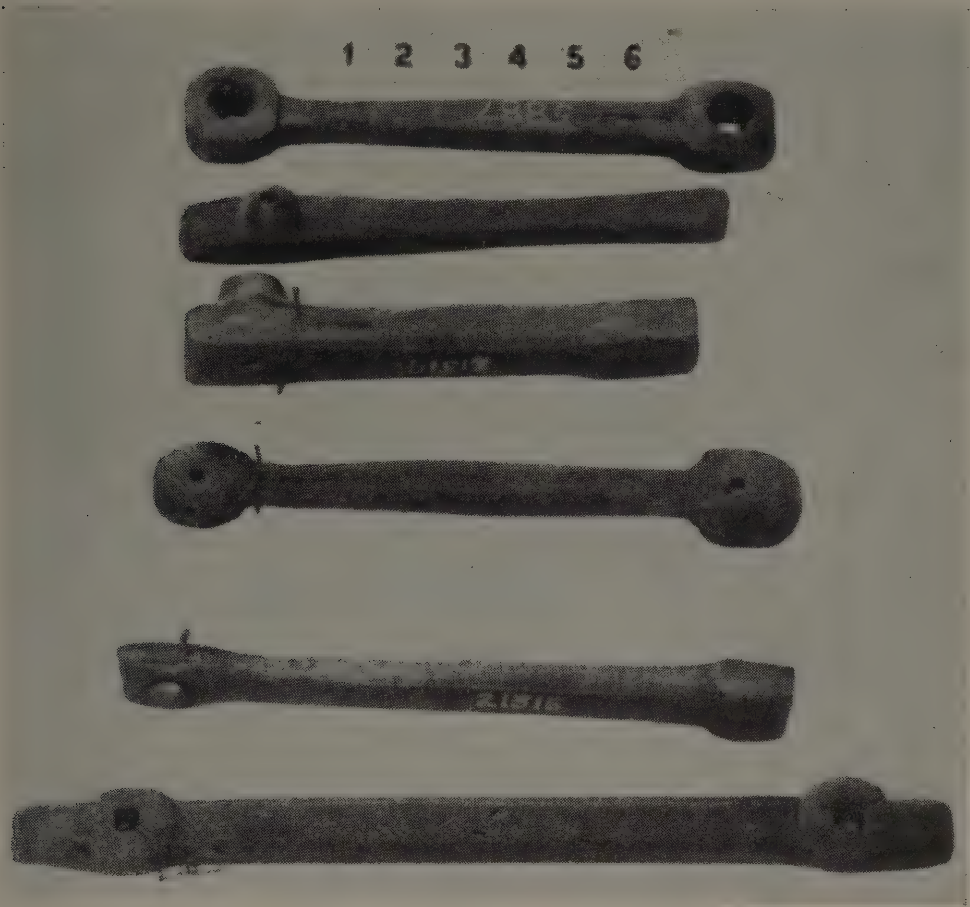


Nail-Heading Tools

A. Ancient type of nail-heading tool that was driven into a block of wood. It has a square nail hole at the top. B. A similar device with a chisel side attachment to cut the hot nails to gauged length and a lever hinged under the nail point which rising by an end-tap released the finished nail. C. Heading tools for bolts (After Diderot). D. A common Anglo-American device. Tool is wedged fast horizontally upon a spring between two anvil tops. Nail is released by a vibration of spring produced by a down tap of a hammer (After Diderot). E. Heading tool (After Diderot). F. Chinese nail-heading tool, an iron bar encircled by a top rim, topped with a little square hole, 1¼ inches deep. Bar was held vertically in left hand in an anvil until hot nail was headed in the hole. Then bar was turned sideways and nail knocked out of the hole by side hammering the head. Was in use by Chinese blacksmiths in 1927.

(From *Ancient Carpenters' Tools,* by Henry C. Mercer) nail up a partition "with cut nails before holes could be bored in half the boards for wrought nails."

The term *penny* when used to indicate the size of nails is thought to be a corruption of pound. For example, a 4 penny nail was such that 1,000 of them weighed 4 pounds. A 10 penny nail to the number of 1,000 weighed 10 pounds. Originally the "hundred" when applied to nails was 6 score or 120; consequently the thousand was 12,000.[8]



NAIL-HEADING TOOLS

Used by blacksmiths since Roman times to head hand-wrought nails. Used widely in the United States until about 1800 when they were largely displaced by machine-made cut nails.

(From *Ancient Carpenters' Tools,* by Henry C. Mercer)

In "Harper's New Monthly Magazine" for July, 1860, there appeared by J. R. Chapin an account of a trip on the Morris Canal that started at Jersey City and ended at Boonton at which place a visit was made to the East Jersey Iron Manufacturing Company that was chartered by the New Jersey Legislature in 1830. The blast furnace is described as being some forty feet square on the ground and forty feet high. It was fed continually with coal, limestone (as a flux) and iron ore in the proportion of 40 to 50 tons of ore, 40 tons of coal, and from 10 to 15 tons of limestone. The blast machinery consisted of an immense water wheel to the shaft of which were attached two cranks and piston rods which worked a pair of double action bellows. Air was forced into a compression tank and from there it was carried through pipes to the ovens over the furnace, where it was heated. From there it finally entered the furnace and was brought into contact with the molten ore. There were 140 tons of material in the furnace at one time.

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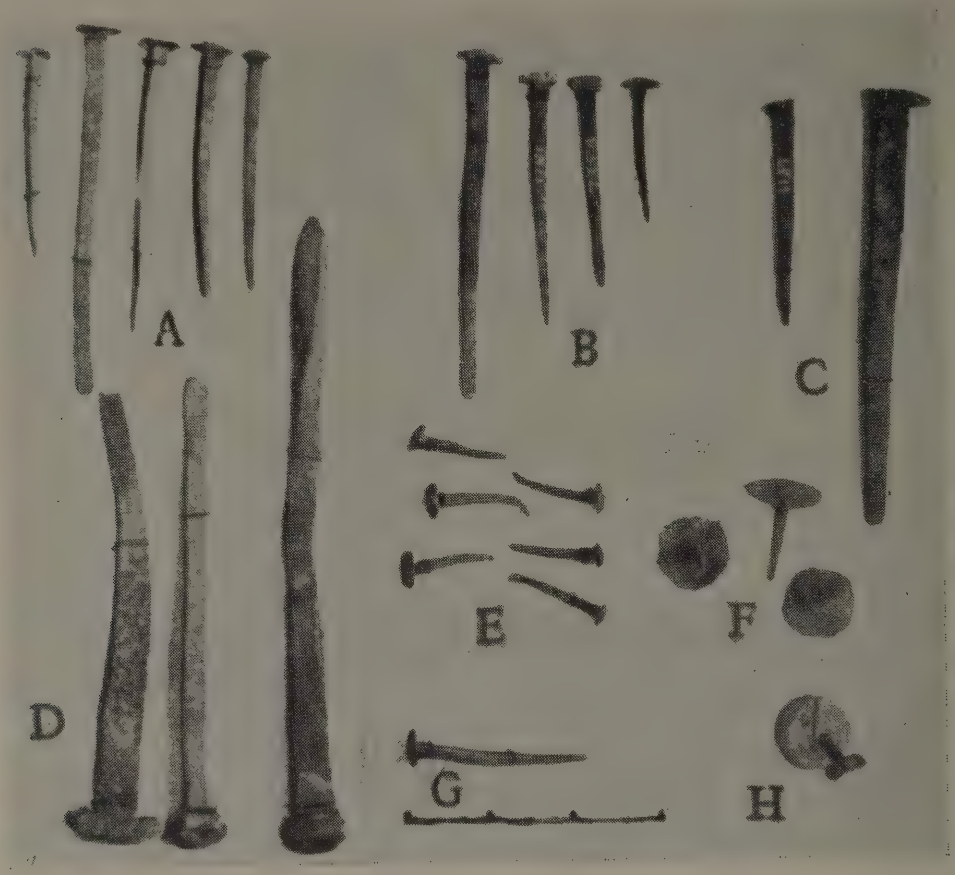
[8] *American Cyclopaedia.* New York, 1885, XII, p. 25.



WROUGHT NAILS

A. Rose nails. B. Clasp nails. C. Brads, headless or with L-shaped heads. D. Spikes. E. Wrought lath-nails. F. Scupper nails, large headed. G. Machine-made wrought nail. H. Nail with decorated head, hammer flattened into two opposite oval projections.

(From *Ancient Carpenters' Tools,* by Henry C. Mercer)

After describing the manufacture of pig iron, the account follows the pigs to the building where puddling took place in nine furnaces. The pigs were heated to a red heat before being transferred to the bottom of the furnace where they were melted. Half a ton of iron represented a charge. The pigs, being in a crude state, contained a considerable amount of sand, cinders and other impurities. Puddling got rid of impurities. After the iron had melted to the consistency of cream it was churned by long iron bars in the hands of puddlers, who continually worked it about for two hours. By that time they had worked it into "balls" each weighing about 100 pounds. These "balls" were "drawn" and carried to a squeezer on a small iron truck. Water was thrown upon the ball as the truck started. The squeezer was an iron-toothed, corrugated wheel running horizontally within a case which surrounded it leaving a space between in which the molten mass was rolled, squeezed and compressed. This forced the cinders out. After the squeezer was through with it, the mass assumed a cube shape and in this condition a new operator with a pair of tongs dragged it off to a machine which altered its shape and consistency (probably a trip hammer) so that it could enter two or more sets of rollers in pairs with grooves of different sizes where the cylindrical mass was gradually compressed into the shape of a long bar or sheet. The bars were cut into plates by semicircular pieces of iron, with cutting edges, operated by a large water wheel.

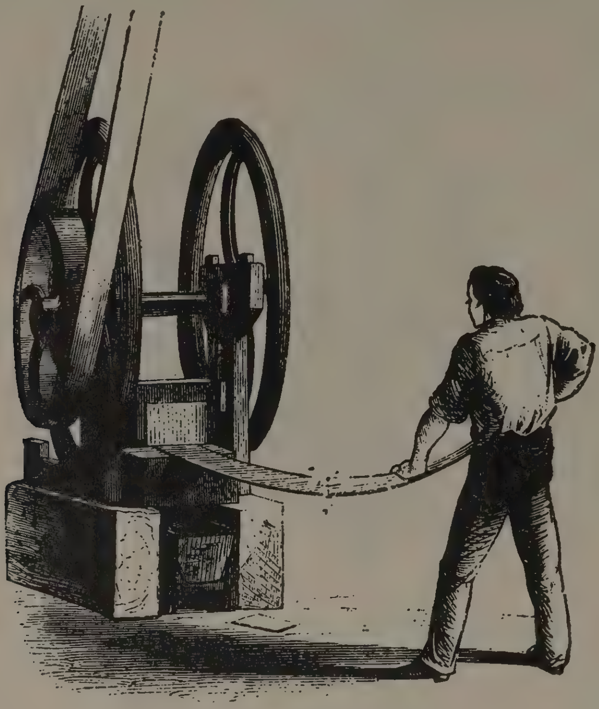
Cutting the Bars

East Jersey Iron Manufacturing Company, Boonton, N. J., 1860.

("Harper's New Monthly Magazine," July, 1860)

The plates still contained traces of foreign matter. To get rid of this the plates were transferred to a re-heating furnace. Here they were placed in a fire and just when they were white hot previous to melting they were drawn out and slung across the floor to a rolling machine where they were made thinner and wider than before. Then they were allowed to cool. Next the nail plate entered the cutting machine in which it was cut across its length into plates about a foot long and of a width to suit various nail sizes. The cutting machine consisted of a double-crank shaft. On either end was a fly-wheel and a band-wheel. "Two arms were attached at one end to the crank, and at the other to a wrought iron cutter, which, moving in grooves in the heavy frame, rises and falls at each revolution of the wheels, and, in descending, crosses the face of a stationary block on which the plate or strip is fed, and cuts off a plate." These nail plates were then heated to a deep red before being ready for the nail machines.

The nail machine cut off a long tapering strip of the nail plate and formed the head, and the nail then dropped down an incline into a box. The plate as it came from the cutting machine had its fibers running in the direction of its length. This was cut transversely into strips in which the fibers ran crosswise. A transverse cut in this strip resulted in a nail with lengthwise fibers. The operator or feeder of the machine held a staff or stick, one end of which rested in a prop or vertical support behind him to steady it, and a clamp at the other end held the plate. It was necessary to turn the plate at each cut, and because the machine moved rapidly the feeder needed skill which he got after much practice. After a plate was cut up, the remnant was thrown aside to be reheated as scrap. A machine for cutting "twenty



CUTTING NAIL-PLATES

East Jersey Iron Manufacturing Company, Boonton, N. J., 1860.

("Harper's New Monthly Magazine," July, 1860) penny" nails moved at about one-eighth the speed of one cutting "eight penny" nails. When a box was full of cut nails it was emptied into a bin. From the bin the nails went into nail casks and were ready for market.

The company had 115 of these machines into which the nail plates were fed, and from which completely finished nails emerged and dropped into a receiving box. The machines were gauged to cut different sized nails.

EARLY NAIL PRODUCTION AND NAILERIES

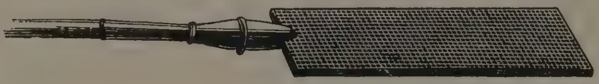
The following table which incorporates the nailery results of the 1810 Federal Census shows that in 1810 there were 11 naileries in New Jersey which produced 957,480 pounds of nails valued at $96,346.

NEW JERSEY NAILERIES IN 1810

County	No. Naileries	Production (pounds)	Value (dollars)
Essex	3	31,360	3,136
Sussex	1	56,000	5,000
Burlington	1	358,400	32,000
Monmouth	1	1,000	250
Morris	2	268,800	26,800
Middlesex	1	40,320	4,000
Somerset	1	......	5,000
Bergen	1	201,600	20,160
Totals	11	957,480	96,346

Gordon in 1830 listed only one nail factory, this being in Bridgeton, Cumberland County. It had 29 nail machines and produced 1,500 tons annually. In 1840 Barber and Howe listed one nail factory in each of the counties of Cumberland and Morris. The 1850 census recorded for New Jersey 54 iron rolling mills. In iron forges, rolling mills, etc., 2,681 men were employed. There were also 126 nail manufacturers. In 1860 there was one nailery in Morris County which had $70,000 invested, which used $396,200 worth of raw materials, employed 196 hands, which spent $84,000 for labor and whose products were valued at $568,341 yearly. There was another nailery in Cumberland County which had invested capital of $300,000, which spent $237,000 for raw materials, employed 350 hands, which spent $108,000 for labor and whose products were valued at $400,000 annually. This was the Cumberland Nail and Iron Company of Bridgeton, noted elsewhere in this book.

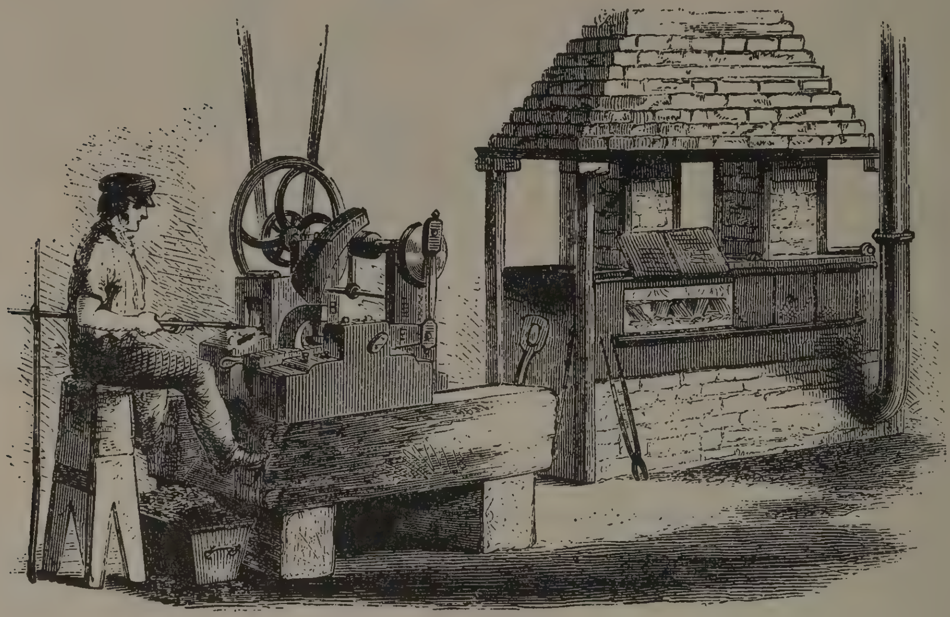
The following list of early New Jersey naileries is not thought to be complete. It was compiled from the sources indicated. The 1690 record seems to be very early for a factory. Perhaps a local blacksmith specialized in making nails. Richard Dean, a "naylor" of Philadelphia, Pa., figured in three land transfers in Salem County, New Jersey, as early as 1690. In 1692 he bought property in partnership with two brothers near Stowe Creek. This is the earliest mention that could be found about a nailer who owned property in New Jersey, although there may be mention of some early ones in Pennsylvania records.



CLAMP AND PLATE

East Jersey Iron Manufacturing Company, Boonton, N. J., 1860.

("Harper's New Monthly Magazine," July, 1860)



FURNACE FOR HEATING PLATES, AND NAIL MACHINE

East Jersey Iron Manufacturing Company, Boonton, N. J., 1860.

("Harper's New Monthly Magazine," July, 1860)

Toward the end of September, 1765, a nailer named John Bryan, belonging to Edward Brumall, of Oxford, Maryland, found himself committed to the Burlington County jail as a runaway. In a notice in "The Pennsylvania Gazette" of November 28, 1765, the jailer said that his pock-marked prisoner, 5 feet, 3 inches high, would be released if his master came forward and paid charges for three weeks from the date of the notice. If no one claimed him within that time he would be sold for the amount of the charges.

1690. Littell, ..., Burlington. According to Woodward and Hageman, a nail factory was established here in 1690. (*Hist. Burl. & Mercer Cos.* Philadelphia, 1883.)

1768. Riggs & Hadden, Newark. A person who understood the nailing business in its different branches or who had been employed as a nailer was wanted by this firm. Such a person, bringing proper recommendations, would meet with good encouragement by applying to Joseph Riggs or Joseph Hadden in Newark, who were entering "largely" into the nailing business. ("The New York Gazette and the Weekly Mercury," April 11, 1768, Suppl.)

1771. Hoffman, Nicholas, and Samuel Ogden, Boonton. A single man who understood the nailing business was wanted immediately by Hoffman and Ogden. Applicants, if well recommended, were to see Nicholas Hoffman in New York or Samuel Ogden at Boonton. This notice appeared in "The New York Gazette and the Weekly Mercury" of July 15, 1771. In "The New York Gazette" of April 24, 1775, Samuel Ogden at Boonton wanted several persons who understood the nailing business. In the "New York Packet and the American Advertiser" of October 11, 1781, Sam Ogden advertised the following sizes, "Crad Tacks, Saddlers Tacks, of all sizes: 3d. nails for Lathing, 4d. ditto for shingling: and also 6d. 8d. 10d. 12d. 20d. and 24d. Nails. Best Refined Rod-Iron, also to be sold."

1774. Morrell, Jonathan, Elizabeth Town. Advertised for two, four, or six nailers. ("Rivington's New-York Gazetteer," Sept. 2.) Morrell also sold rum, groceries and dry goods.

1774. Neil, Robert, Jr., Newark. Advertised for two or three single men who understood nailing. ("The New-York Gazette and the Weekly Mercury," Dec. 12.) In 1775 Mr. Neil advertised again for two or three unmarried nailers in the "Pennsylvania Journal" of Jan. 18.

1775. Morrison, Isaac, Newark Mountains. Advertised for a sober person who understood the nailing business, to take care of a shop and instruct two lads in the business. ("New York Gazette," Jan. 23.)

1776. Faish, John Jacob, Mount Hope, Morris County. Advertised for three or four nailers. ("The New York Gazette and Weekly Mercury," June 17, 1776.) Faish was a well-known iron master of Morris County who came to America in 1764 from Switzerland, where he was born, to act as superintendent for the London Company for 7 years.

1777. Mount Holly Iron Works, Mount Holly. This firm advertised for a number of forgemen and nailers to whom "best wages" and "continuous employment" were offered. Woodchoppers also were needed. Applicants were to apply to Colonel Cox in Philadelphia or to Richard Price at the works. ("The Pennsylvania Evening Packet," May 27, 1777.) In the "Pennsylvania Evening Post" of June 26, 1777, a notice advertised for laborers, colliers, forgemen and nailers, who were wanted both at Mount Holly and Batsto.

1778. Little, John, New Mills (Pemberton). Made nails, camp-kettles and other iron work for the Continental Army. Samuel Cooper, a staunch Whig, was interested with John Little in a saltworks at Little Egg Harbor. (Annals of Camden, No. 1, by Charles S. Boyer.)

1779. Mount-Hope and Hibernia Furnace, Morris County. Furnace three miles north of Dover. Advertised nails as well as pots, kettles, scythes, smoothing irons, etc., for sale for cash or exchanged for country produce. ("New-Jersey Journal," June 22, 1779.) In "The New-York Journal and the General Advertiser" of Sept. 24, 1781, the Mount-Hope Furnace continued to advertise nail rods and nails for sale.

1780. Union Iron Works, Hunterdon County. Nail rods of good quality sold. Robert Taylor. ("New Jersey Gazette," Dec. 6, 1780.) Built before 1742.

1788. Blacksmith and Nail Manufactory, Elizabeth-Town. Two boys about 12 or 13 years of age were wanted as apprentices in the above manufactory. For particulars they were advised to apply to the printer of "The New-Jersey Journal and Political Intelligencer," according to the issue of March 5, 1788.

1793. Perrine, Peter, New Brunswick. This nail manufactory was located in Queen Street south of the Dutch Church. His nails were made of the best quality of Philadelphia iron. He had just started a nailing business. Mr. Perrine wanted two or three apprentices also. ("The Guardian," April 24, 1793.)

1797. Thompson, Archibald A., New Brunswick. This "Nail Manufactory" was located "opposite Simon Hillyer's Tavern, a few doors below James Schureman's Store, Burnet-street." Any quantity of nails of different sizes were available on reasonable terms. ("The Guardian," April 25, 1797.)

1797. ...., Burlington. Nail manufactory in operation. (Bishop, J. Leander. *A History of Amer. Manufactures,* Vol. I.)

1804. State Prison, Lamberton, near Trenton. Henry Bellerjeau, Keeper of the State Prison. During 1804 and 1805, the Keeper advertised for many weeks in "The True American" of Trenton, "a large quantity of cut-nails and brads" for sale at the State Prison, together with shoes for men and women, "Chip Hats," fire buckets and rush-bottomed chairs. In "The True American" for March 2, 1807 and later, the kinds of nails advertised were 20d, 12d, 8d, 6d, 4d, and 3d. Brads were 8d, 9d, 10d, and 12d. Wrought nails of several sizes were also offered on reasonable terms.

In the "Aurora" (Phila.) of January 15, 1808, cut and wrought nails were advertised for sale and the sizes were mentioned. According to "The True American" of November 25, 1811, prison-made nails were offered by the ton and upwards at the following prices:

3d at 12 cts. per lb.
4d at 11½ cts. per lb.
6d at 10½ cts per lb.
8d at 8½ cts. per lb.
10d at 8½ cts. per lb.
12d at 8½ cts. per lb.
20d at 8½ cts. per lb.

By the keg the prices all advanced ½ cent per pound. Wrought nails were sold by the keg at the following prices per pound: 6d at 18 cts.; 8d at 13½ cts.; 10d at 13 cts.; 12d at 12½ cts.; and 20d at 12½ cts. Sixty days credit was given to purchasers of from one to five tons, and ninety days to purchasers of five tons and over. Notes with security could be required.

The first state prison lasted from 1797 to 1836. According to the report of a legislative committee made on February 22, 1804, the chief productive industry of the prison was nail making which employed 40 out of the 61 employed inmates. Nail making remained important until it was destroyed by competition from England following the War of 1812. In 1804 there were 69 prisoners. Ten of these were employed in cutting nails, 23 in heading nails and 4 in making wrought nails. Prisoners were allowed 3 shillings per day for cutting nails and brads. In 1814 the prison nailery showed a profit of $1,380.81. Each prisoner was charged with the cost of his maintenance. Because the capacity of the prison was limited, many prisoners were discharged before they were able to earn the cost of their support. On February 3, 1818, the Speaker of the House laid before it a report from the Inspectors of the State Prison in which it was stated that the manufacture of nails, previously a productive employment for the men, had, instead of showing a profit to the prison, declined considerably owing to the reduction in price of nails. Private manufacturers of nails in the vicinity of large cities were selling nails for less than the prison could make them. Large shipments from England also depressed the price. On October 1, 1816, there were 963 kegs of nails unsold, and on the same date in 1817 the number of unsold kegs amounted to 1,784, an increase of 821 kegs. Of 112 prisoners, 30 were engaged in cutting and heading nails and 10 were making wrought nails.

COLONIAL FAMILY MAKING NAILS

The rough iron was inserted into a clamp or vise and the head and point were shaped by hammer blows.

(Courtesy of American Iron and Steel Institute)

The nail factory account on October 1, 1829 was as follows:

Amount of inventory		$532.29½
Amount expended, 1 pair bellows, and freight on sundry articles		5.80
Entire amount expended		$538.09½
Articles sold	$28.19¾	
Amount of inventory, Oct. 1.29	519.97	548.16¾
Profit for year		10.07¼

(*Report of the New Jersey Prison Inquiry Commission.* By Harry E. Barnes. Trenton, 1917.)

1805. Nailery on Crosswicks Creek in Burlington County. Lucius Q. C. Elmer, in "History of the Early Settlement and Progress in Cumberland County, New Jersey," recalled having seen, "in the year 1805, the first machine for cutting and heading nails at one operation ever invented." This was on Crosswicks Creek. The machine was complicated, and the patent obtained by the Messrs. Reeves (See 1815, Benjamin and David Reeves) "was soon much simplified."

1811. Low, James B., New Brunswick. Mr. Low had a Cut Nail Factory on King Street, three doors north of Mr. Keyworth's City Tavern, New Brunswick. He had just obtained a new and complete set of machinery and a large stock of the best iron and was able to supply nails equal to any in the state. ("The Fredonian," Jan. 26, 1811.) His advertisements continued during 1812, 1813 and 1814.

1814. Rolling & Nail Mill, Paterson, Essex County. This mill. a small frame building, was built in the fall of 1812 by Samuel Colt, Nicholas Delaplaine and Roswell L. Colt. The firm made shovels, spades, kettles, frying pans, etc. In 1814 the manufacture of nails was started. Swedish and Russian iron was imported, for that purpose, in strips 9 or 10 feet long and as wide as the length of a nail. The nails were cut at first by machinery and headed by hand. Later, machinery that cut and headed the nails in one operation was used. In 1815 the rolling mill was closed but nails continued to be manufactured. About 1828 the nail making was discontinued because it was unprofitable. At that time 25 men were employed and $60,000 worth of nails were made annually. (W. Woodford Clayton and William Nelson. *History of Bergen & Passaic Counties, New Jersey*. Phila., 1882.)

1815. Reeves, Benjamin and David, Cumberland Nail and Iron Company, Bridgeton. In 1815 Benjamin and David Reeves bought ½ of the water power near the foot of North Street (previously operated as a sawmill) and started a nail factory. At that time nails were made from the best Swedish iron and sold for from 10 to 15 cents per pound. The property was owned by Abraham Sayre and at his death in 1820 the Reeves bought the property with the gristmill and moved the gristmill to their works on the west side of the Cohansey River. The works burned in 1824 but were rebuilt on a larger scale. In 1843 nails were made by cutting them lengthwise of the grain instead of crosswise. This improved them. Their business increased steadily, and in 1847 a rolling mill was built on the east side of the creek and operated by steam boilers. Rolling of iron on the west side was discontinued. Benjamin Reeves died in 1844 and the firm became Reeves, Buck & Co. In 1852 it was incorporated as the Cumberland Nail and Iron Co. In 1822 the firm had 16 nail machines capable of cutting 10 tons of nails weekly, and 26 hands. By 1880 they were employing about 400 men and produced 140,000 kegs of nails and 4 million feet of gas and water pipes yearly. They then had 84 nail machines, 10 double puddling furnaces, 4 heating furnaces, 2 trains of rolls and 6 furnaces for welding gas and water pipes. (Thomas Cushing and Charles E. Sheppard. *History of the Counties of Gloucester, Salem and Cumberland.* Phila., 1883.) When the concern was incorporated March 25, 1852 as the Cumberland Nail and Iron Company (Laws of New Jersey, 1852, p. 459-461) David Reeves, Samuel J. Reeves, Robert S. Buck, Robert C. Nichols and Daniel M. Woodruff declared that the purpose of the company was to manufacture nails and iron, in all its branches. The capital stock was $200,000 with power to increase to $300,000 divided into shares of $50 each. Business was to start when $150,000 capital stock was subscribed. The act was to continue in force for 30 years. A supplemental act of 1857 authorized the company to increase its capital stock to $500.000, and extended its corporate existence to December 31, 1881. Robert C. Nichols was the manager, and in 1856 the firm's real estate was assessed at $266,000. Business was suspended before the close of the nineteenth century owing to changed conditions in the manufacture of nails and pipe, according to William C. Mulford in his *Historical Tales of Cumberland County* (1941), and in 1903 the City of Bridgeton acquired the lakes, raceway and other lands that had been owned by the iron works for the water rights and for use as a public park.

1818. REEVE, MARK, Medford. His shop was located "on the corner of the front yard at the present [1883] residence of Mrs. Mary Collins, opposite the store of D. W. Geist, on Main Street, Medford." Mark Reeve, who died around 1818, is credited with making the first cut nails with heads ever manufactured in this country. He was an inventive person, and his name and that of Richard Reeve, both of Philadelphia, are mentioned in connection with nail patents in the "American Encyclopedia," 1885. The machinery in his shop was primitive and operated by horse power. His nail business was not much of a success. (Woodward and Hageman, *Hist. Burl. & Mercer Counties, N. J.*, Phila., 1883.) According to DeCou, the name Medford is said to have been given to the village early in the nineteenth century by Mark Reeve, who returned from a visit to Medford, Massachusetts, so impressed with the town that he advocated changing Upper Evesham to Medford. His idea was adopted and in 1820 when the first Post Office was opened, the official name of the town became Medford. (Geo. DeCou. *Historic Rancocas,* p. 196.)

1818. OFFLEY, JOHN N., New Mills, Burlington County. At his factory Mr. Offley had a constant supply of a general assortment of cut nails and brads for sale on reasonable terms. He also sold hoop iron and English and cast steel of a "Superior Quality." His advertisements continued during part of 1819 also. On April 7, 1819 his prices for cut nails and brads were "8-10 & 12 at 8d per lb. 3-4- & 6 at 10d per lb." ("The Burlington Mirror," Nov. 18, 1818.) On May 15, 1819 he advertised his "Burlington County Nail Factory" in the "Trenton Federalist." As it does not seem probable that there were two nail factories in New Mills, perhaps John N. Offley rented the factory of Thomas R. Lacy or perhaps he was a dealer who wanted his customers to think that he had a factory of his own. (See 1820, Thomas R. Lacy.)

1820. LACY, THOMAS R., New Mills (Pemberton), Burlington County. On June 7, 1820, Thomas R. Lacy offered for sale his half interest in the estate at New Mills, which he held jointly with Anthony S. Earl. The estate included a gristmill, a new sawmill, a carding house with two carding machines, picking machines and spinning billy, a forge with three fires and two hammers, and a nail factory with two of the newest machines. The entire property was situated "on both sides of the North main branch of Rancocas Creek at the Village of New-Mills, six miles East of Mount Holly, the Seat of Justice of the County of Burlington." In addition the estate included other property such as a storehouse and dwelling houses. Lacy in the announcement also offered for sale real estate belonging exclusively to him, including his own large, brick dwelling and out buildings (the former residence of Col. Thomas Reynolds) "on the west side of the street at New Mills." (New Mills became Pemberton in 1826.)

1821. LINANT, ANDREW, New Brunswick. Linant's cut nail manufactory was in Church Street next door to Elias Molleson. He sold nails and brads 8d, 10d, 12d, and 20d at 10 shillings per pound and at $9.00 per hundred pounds. ("The Times and New-Brunswick Advertiser." June 28, 1821.)

1825. JOHN COLT & Co., Paterson. Rolling and slitting mill and nail factory. This firm employed 23 hands and had an annual production of around 672,000 pounds of nails. They were in business in 1829. (*Rev. Samuel Fisher's Census of Paterson,* by D. Stanton Hammond. Bull. Passaic Co. Hist. Soc., Aug., 1958.)

1827. DOVER IRON WORKS, Dover. Among other items this firm advertised cut nails of all sizes, spikes, and horse nail rods. ("The Jerseyman," Sept. 12, 1827.)

1852. EAST JERSEY IRON MANUFACTURING COMPANY, Boonton, Morris County. This firm was chartered by the New Jersey Legislature in 1830. In 1853 it was being operated by Fuller & Lord. From Oct. 1, 1852 to May 1, 1853, the firm in addition to other activities had 73 nail machines worked by 100 hands. These machines produced 57,179 kegs of nails of 100 pounds each. In 1864 the firm produced 173,000 kegs of nails. In 1872-3 they had 100 nail machines in their upper nail factory which produced 250,000 kegs yearly. Their lower nail factory contained 25 machines and produced 10,000 kegs yearly. The lower mill in 1875 had 50 machines and a capacity of 30,000 kegs yearly. A large part of their resources was devoted to making nail plates from which the nails were made. (Halsey, E. D. *Hist. Morris Co.,* New York, 1882.)

1860. WILSON, A. T. & Co., Camden. This firm built a factory in 1860 for the production of cut nails. It was located on Front Street, Camden, adjoining a rolling mill that had been built in 1854 at Cooper's Point near the head of Third Street by Brink & Durvin. The rolling mill subsequently changed hands several times. There were about 400 persons employed in the rolling mill and nail factory. They ceased business about 1870. (Geo. R. Prowell. *The Hist. of Camden Co., N. J.* Phila., 1886.)

1863. OXFORD IRON COMPANY, Oxford. This company was incorporated in 1863. Shortly a new furnace with a 33-ton daily capacity was built, also a rolling mill, nail factories, etc. Yearly output of nails was 240,000 kegs. Company employed 750 men and used 60,000 tons of coal yearly. Tons of ore mined yearly was 30,000. (*Ms. Notes on the Oxford-New Jersey Furnace,* by Charles Rufus Harte. New Haven, Conn. 1940.) A. G. Yount in his article "The Old Oxford Furnace" ("Compressed Air Magazine," May, 1943) gives 1869 as the date for the organization of the Oxford Iron Company, but apparently 1859 is meant. In 1878 the firm became bankrupt and was succeeded by the Oxford Iron & Nail Company. Business closed in 1895.

On December 10, 1777 there was adopted at Princeton an act for regulating and limiting the prices of various items to "prevent forestalling, regrating and engrossing." At that time the price of bloomery bar iron was fixed at 60 shillings per hundredweight; refined iron, 70 shillings per hundredweight; pig-metal at 20 shillings per hundredweight. The maximum price of rolling iron was fixed at 30 pounds per ton.

In order to stop merchants from charging excessive prices, the Burlington County Committee on July 21, 1779 fixed the price of nail rod iron at 50 pounds per hundredweight for the month of August.

Notices of merchants who had iron, rods, nails, etc., for sale frequently appeared in the advertising of early New Jersey newspapers.

Joseph Milnor of Trenton, according to "The New-Jersey Gazette" of December 15, 1779, had for sale at his store a large quantity of bar and slit iron, and nails by large or small quantities. He also sold dry goods and groceries. John Ramsey, formerly of Bottle Hill, advertised in "The New-Jersey Journal" (Elizabeth) of July 12, 1780 that he had a quantity of excellent nails to exchange for Indian corn. Robert Taylor, of the Union Iron Works, offered nail rods of good quality in "The New-Jersey Gazette" of December 6, 1780. A quantity of fine drawn, wrought nails, 8, 10 and 12 penny, was offered at reasonable terms by Willett Warne at his store in New Brunswick in "The Guardian" of February 23, 1796. J. L. James of Bridgeton had goods and nails to be exchanged for old wrought and cast iron. His notice appeared in various 1825 and 1826 issues of "The Washington Whig & Bridgeton Observer and Cumberland, Cape-May & Salem Advertiser," that was published in Bridgeton. Finally, in "The Fredonian" (New Brunswick) of April 1, 1824, Richard Duryee, Jun., of New Brunswick, had for sale at his hardware store, on Church Street opposite the Post Office, thirty casks of cut nails. He also sold English powder, shot and flints.

During the year ending September 30, 1790, 1,579,947 pounds of nails and spikes were imported into the United States. After the last day of June, 1794, there was a duty of two cents per pound on nails, and one cent per pound on spikes imported into the United States. In 1789 the duty had been one cent per pound on nails and spikes.

Howard R. Kemble has discovered for us an account of a nail factory and a probable fatality in nearby Pennsylvania. "The New Jersey Mirror" of January 10, 1827 printed a story about an accident that happened to a wagon driver on the evening after Christmas, 1826. This carter, in the employ of Captain Henry Moore, was returning to the Nail Factory on Chester Creek, in Aston township, and in order to check the oxen while descending a short hill near the works he jumped from the wagon and slipped, falling before the wheels which pushed him forward a considerable distance before passing over his body. "As soon as it was discovered that he had not returned with his team, search was immediately commenced. He was found in the road, and carried home; faint hopes are entertained of his recovery. This is another caution against participating too freely of ardent spirits."

In the "History of Delaware County, Pennsylvania," by Henry Graham Ashmead, there is an account of the old iron works which before 1785 were established on the opposite side of Chester Creek from the nail works. In 1809 Captain Henry Moore, who then was in charge of the forge and rolling mills on the other side of the creek, owned by his brother-in-law Thomas Odiorne, erected on an island in the creek at Rockdale a nail factory and set up nine nail machines. This factory manufactured 100 tons of iron into nails in 1810. These were sold at an average price of ten cents per pound. The factory capacity was gradually increased, and in 1826, 150 tons of nails were made. By 1832 the annual production had reached 400 tons. In this year Richard Smith, a Philadelphia wholesale hardware dealer, took over the works to cover advances made to Captain Moore.

There were other nail factories in nearby Pennsylvania which undoubtedly supplied some of the nails used in New Jersey. John Taylor started a forge in 1742 on Chester Creek at a place now known as Glen Mills. This developed into a slitting mill by 1746, at which nails were made. This is supposed to have been the first rolling or slitting mill in Pennsylvania. It is believed that his storekeeper in making one of his periodic visits to England astonished Liverpool merchants by telling them that he could buy nails at Taylor's mill at prices lower than the ones they quoted, a statement that added fuel to the movement in England which culminated in the 1750 act of Parliament prohibiting the erection of slitting mills in their American colonies.[9]

In Thornbury Township, Delaware County, Pennsylvania, John Edwards, his son and a Mr. Kelton, operated rolling and slitting mills in 1826. These developed from the slitting mill built by Nathan Edwards in 1816. In 1829 nail manufacturing was started. In Upper Providence Township, David Register began making wrought-iron nails by hand, and employed men for this purpose. This was in 1812-13. His factory, a small frame building which he rented from Jesse Reece was, after many years of disuse, washed away in the flood of August 5, 1843.[9]

Before 1689 a grist and a saw mill were built at the juncture of the Wissahickon Creek and the Schuylkill River (Phila., Pa.). At this time there were three owners. In 1691 the three owners sold the two mills to Andrew Robeson, Sr., of West Jersey, and to Charles Saunders. For 150 years the Robeson family owned the mills. Andrew Robeson, Sr., and his wife and nephew, Andrew, 2nd, had come to West Jersey in 1676 and in the same year Andrew Sr. was Surveyor General of West Jersey and laid out the dividing line between East and West Jersey. In 1694 he died and his nephew Andrew, 2nd, bought his half interest in what were then known as the "Wissahickon Mills." The mills passed through three ownerships and the number was increased to three mills by June 16, 1789, when they were bought by Peter and Jonathan Robeson, grandsons of Andrew, 2nd. Other owners followed and according to Chadwick, the historian of Roxborough, one of the mills on the edge of the Schuylkill "was the first cut-nail factory in America." However, no date is given.[10] The family that owned this cut nail mill was prominent in New Jersey's iron industry and civil history. Andrew Robeson, 2nd, became judge of Gloucester County in 1692. Morris Robeson was a purchaser of Martha furnace, 1809, a builder of Weymouth furnace about 1800 and a purchaser of Oxford furnace in 1809. Two of Morris' grandsons lived in Camden. George M. Robeson was Secretary of the Navy under President Grant, and Morris R. Hamilton, editor of the "Camden Democrat" 1860-1865, later in charge of the "Newark Journal," was subsequently State Librarian, 1884-1889.[11]

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[9] Ashmead, Henry Graham. *History of Delaware County, Pennsylvania.* Phila., 1884.

[10] Macfarlan, Douglas, "Mills of the Wissahickon." Germantowne Crier, Vol. 4, No. 2, July, 1952, pp. 15, 29.

Alice Morse Earle in her book on "Home Life in Colonial Days" mentions the scarcity and high price of nails during colonial times, especially in Maryland and Virginia, and states that in some instances persons leaving their small houses set them on fire in order to rake out the nails from the ashes. To prevent this, the government of Virginia gave to every planter who left his house as many nails as the house was thought to have, provided the owner would not set it on fire. (Hening, W. W. "Virginia Statutes at Large," I, p. 291.) The importance of nails is further indicated in the chapter on Hoboken in Charles H. Winfield's "History of the County of Hudson, New Jersey" (New York, 1874) in which it is stated that in March, 1656 he sold his frame house at Hoboken to Michael Jensen and on the 28th of that month he asked for six or eight government soldiers to help him in getting it away. However, the Indians claimed the frame, except the nails, and his request was denied on the ground that the Indians might start a fight which would spread.

In concluding this nail account, reference should be made to Seth Boyden, born in Foxboro, Mass., in 1798, who moved to Newark, N. J., in 1815 and at the age of 21 invented a machine for making "wrought nails." Later he invented a machine for cutting brads, and one for cutting and heading tacks, as well as important devices in other fields. ("Dictionary of American Biography.")

Finally there was Matthias Matson, yeoman, of Old Gloucester County, who ordered in his will of May 18, 1767 that he be buried on his plantation and no where else, specifying that "Burying ground where I am to be buried to be done up with cedar boards, and nailed on posts, and it is always to be kept up by them that lives on my place afterwards." Mr. Matthias apparently believed that the wrought iron nails in use during his time would help in preventing trespassing and insure protection after burial.

An old-time storekeeper, John Imlay of Bordentown, New Jersey, in his ledger dated from 1751 to 1757, mentions among a long list of articles "200 hob nails, 1s. 6d." Hobnails are short, sharply pointed, large-headed nails that were used for studding the soles of shoes.

In the old world and no doubt in the new world, various ageless superstitions involving nails were deeply implanted in the minds of some of the inhabitants. Edwin and M. A. Radford, in the "Encyclopedia of Superstitions" (New York, 1949), mentions several, such as the use of an iron nail to cure the ague. A lock of the patient's hair was nailed to an oak tree. Then the patient wrenched the lock from his head by a sudden jerk and the ague was left behind in the tree. Various illnesses or evils could be nailed to the ground, a tree, a door, etc., and thus be secured while the patient walked away from them.

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[11] *An Historical and Genealogical Account of Andrew Robeson, of Scotland, New Jersey and Pennsylvania and of His Descendants from 1653 to 1916.* J. B. Lippincott Co., Phila., 1916.

THE WOOD SCREW

By wood screw is meant the metal screw designed to be twisted into wood by means of a screw driver and not the early cylinder-type screw that was made of wood and used in early screw presses. During medieval times metal screws were rare. They came into general use in the sixteenth century. Even in the early nineteenth century they were not manufactured with points and a hole had to be bored first as deep as the length of the screw before they could be inserted. In order to obtain spiral precision during early Greek and Roman times, a sheet of soft metal shaped like a right-angled triangle was wound around a cylinder, the arm of the right angle being parallel to the axis. There would then be on the cylinder a spiral traced by the hypotenuse of the triangle. The metal spiral served as a guide for the tool used in cutting the spiral groove. After part of the spiral was cut the metal triangle was moved to an adjoining part of the cylinder, thus lengthening the spiral. Hero (First Century A. D.) devised a screw cutter on the tap and die principle and the screws were made with simple hand tools. Leonardo da Vinci's contributions to the use of the screw in tool making, etc., and for manufacturing screws, were in advance of his time, and although such machines were satisfactory in principle they were useless in practice and long screws continued to be cut with a chisel or file as in earlier times.[10]

According to Knight, a screw-cutting lathe was invented in France as early as 1569 by Besson. It had a guide-screw which advanced the cutting tool at the same time that the work was rotated by a series of cords, pulleys and weights. This machine was improved by Hindley, a watchmaker of York, England, about 1741, but it was used for many years by watchmakers before it was used in machine shops.

A wood screw is a small, threaded shank of iron, brass, etc., with a slit in the top. Its head may be flat with a saucer-like bottom or round with a flat bottom. In the eighteenth century it was made singly by hand by twisting the "screw plate" or "die" or "die-stock" upon its shank. Its threads were often finished to a spiral point with a file. The "dies" were fixed in the "die-stock" which had projecting handles, and as the "die-stock" was turned on the screw rod, the dies cut the thread. For small work a "screw plate" having a series of screw-threaded holes of various sizes, adapted for different-sized wire, was used instead of the dies. The screws made by machinery in the early nineteenth century were blunt pointed unless they were filed by hand. Toward the end of the eighteenth century the hand method of making screws was replaced by numerous lathe devices or screw-threaded spindles cranked by hand. In the early nineteenth century the most important advance took place. There was developed "a continuous-action mandrel lathe, axled on a guide screw, which therefore, advancing as it revolves and clasping at one end the screw shank, threads the latter by twisting it through a knife-edged hole, or, more exactly between two steel-cutting points compressible by a lever." This type of machine, operated by hand or water power, manufactured most of the screws used in the early years of the nineteenth century. However, these screws needed a point and would not penetrate wood unless a hole had been punched or bored previously. Then in 1846 T. J. Sloan, of New York, patented a machine that pointed them.[1]

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[10] *A History of Technology,* Vols. II and III. Oxford, 1956, 1957.

Bishop gives the process of manufacturing screws as it was practiced by the American Screw Company of Providence, R. I., probably around 1860. This firm turned out machine-made screws as early as 1834. The wire of which the screws were made was imported in coils. It was first immersed in acids, then annealed and drawn to the proper thickness. The first of the screw-cutting machines cut the wire to the right length and cut the heads of the blanks. This was done at the rate of about 90 blanks per minute. A "blank" was the name given to the screw at that stage in its manufacture. The next set of machines (on the second floor) shaped the head, cut a groove in the head and trimmed the burr. On the third floor were the threading or finishing machines where the thread was cut at the rate of five screws per minute for each machine and where the screws got their gimlet points. Both shaping and finishing machines were nearly automatic. The screws were then put into hoppers where they were picked up by claws and conveyed to the cutting apparatus where they were held the required time and then dropped into a box. Then the screws were taken to another room to be counted by weighing. About 150 hands were employed by the company in counting, sorting and packaging screws. The firm had 625 machines capable of making 14,000 gross of screws per day. It employed an average of 600 hands (300 male and 300 female) and its monthly payroll was $24,000. The factories used over 3,000 tons of iron and 500 different sizes of screws were made.[6]

The foregoing was assembled upon reading in James S. Brown's recent book, "Allaire's Lost Empire" (Freehold, 1958), that James P.

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[1] *Loc. cit.*
[6] *Loc. cit.*

Allaire, proprietor of the Howell Works (Monmouth Furnace) had a screw factory built some time after 1830, this having been added to the south end of a grinding mill on his property at Allaire in Monmouth County. Brown describes the building as being long, narrow and two storied. The factory was powered by a breast water wheel, the water being supplied through a pipe from a pond. In 1837 water was obtained from a canal that had just been completed. In 1831 two Frenchmen, Frederick and Peter Stokey, were employed to keep the machinery of the factory in order and to instruct the thirty boys and girls that were employed.

An account of the factory was published in "The Monmouth Inquirer" of September 15, 1836 which stated: "Among the many attractions offered to a well ordered mind at the flourishing establishment of the Howell Works Company, there is one particularly indicative of the mechanical genius of our country. I allude to a machine for cutting the head, the wire, and forming the head (to prepare it for being manufactured into a wood screw) technically called a blank machine, the simplicity of design, beauty of workmanship, power of movement and adaptiveness to use, do infinite credit to the skill of its inventor and builder, Charles Makepeace, Esq."

The article said that the machine could turn out fifty to seventy-five screw blanks per minute in a wide variety of sizes. The screws were then threaded on lathes. These were set up in four long rows, extending the length of the building. Brown writes that the screw factory involved Allaire in the first of many law suits. Three Frenchmen hired to set up the lathes disappeared. They were arrested later and accused of having stolen a box of tools. As Allaire was unable to prove this charge, he paid $600 damages for false arrest.

The State Prison at Lamberton (near Trenton) made screws although the extent of this activity is not known. According to a "Report of the Joint Committee of the Legislature of 1816," there was a loss in the screw factory of $12.22 as of October 1, 1814. The nailery on the other hand showed a gain of $1,380.81.[12] It is not believed that screw factories were common in early New Jersey. Gordon in his "Gazetteer of the State of New Jersey" (1834) and Barber and Howe in their "Historical Collections of the State of New Jersey" make no mention of a screw factory. Kirkbride, in his "New Jersey Business Directory for 1850-1851," lists Spencer, Quackenboss & Co., of Raritan, as manufacturers of "wooden screws," wrought nails, etc. In Philadelphia, as late as 1882, screws for wood and iron were manufactured by only 4 firms employing 113 persons (63 men, 17 women, 33 youths) with the value of their products placed at $138,000 yearly.

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[12] Barnes, Harry E. *State of New Jersey Rept. of Prison Inquiry Commission.* Trenton, 1917.

Andrew Thompson, who had a screw cutting and turning establishment in Trenton on Second Street near the State House, advised the public in the October 7, 1842 issue of the "Emporium & True American" that he had been put to great expense in fitting his establishment for cutting screws of all sizes from 10 to 500 pounds in the best style, but it is not definitely known if he made wood screws. He had taken over the business of Seth Lukens.

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